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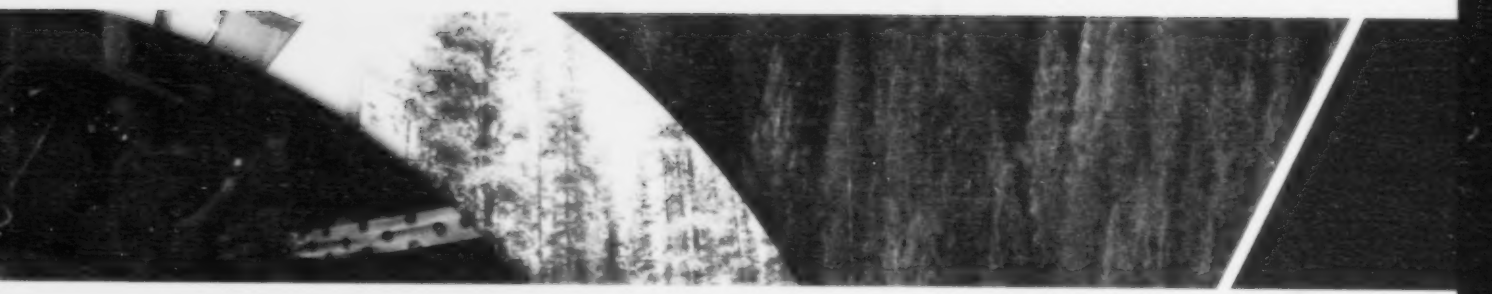

Mountain Pine Beetle Initiative

Interim Report 2005

Natural Resources Canada
Ressources naturelles Canada

Canada

Mountain Pine Beetle Initiative

Interim Report

2005

Natural Resources Canada
Canadian Forest Service
Pacific Forestry Centre
Victoria, BC
Canada

2005

Natural Resources Canada
Canadian Forest Service
Pacific Forestry Centre
506 West Burnside Road
Victoria, British Columbia V8Z 1M5
Telephone: (250) 363-0600
www.pfc.cfs.nrcan.gc.ca

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Executive Summary

The mountain pine beetle infestation attacking British Columbia's pine forests began in the mid-1990s. By 2004, it had exploded across more than seven million hectares, and is now the largest recorded insect infestation in North American history. The epidemic continues to spread and, in addition to its preferred host of mature lodgepole pine, the beetle is killing smaller-diameter lodgepole and other pine species. The current infestation threatens not just the 10.2 million hectares of lodgepole, ponderosa and white pine forests in British Columbia's interior, but also the pine forests of Alberta and the jack pine stands in Canada's northern boreal forest. If the beetle spreads to the boreal forest, the infestation could become a national epidemic.

In order to assist British Columbia in addressing challenges associated with the infestation, the Government of Canada announced in October 2002 the Mountain Pine Beetle Initiative, a six-year, $40-million program to reduce the impact of the current epidemic and the risk of future epidemics. The program is administered by Natural Resources Canada, Canadian Forest Service, and supports the Canadian Forest Service's mandate to promote the sustainable development of Canada's forests and the competitiveness of the Canadian forest sector.

In 2002–03, Natural Resources Canada met with other federal and provincial agencies, First Nations and private landowner associations to develop guidelines for the content and delivery of the Mountain Pine Beetle Initiative forestlands programs. These programs provide assistance to mitigate the impact of beetle outbreaks on federal and private forestlands:

- The *Private Forestlands Rehabilitation Program* provides technical and funding assistance to control beetle outbreaks and to rehabilitate private, non-industrial forestlands after beetle infestation.

- The *Federal Forestlands Rehabilitation Program* provides technical and funding assistance to control beetle infestation and rehabilitate First Nations reserve forestlands, national parks and other federal forestlands within the infestation area, and helps fulfill the Government of Canada's responsibilities with regards to federally managed lands and First Nations reserve lands.

Throughout 2003, Natural Resources Canada hosted a series of regional workshops with sector stakeholders in the beetle-infestation area. Several hundred stakeholders participated in these beetle workshops to identify information needs and to set research priorities. This consultation process provided the basis for the Mountain Pine Beetle Initiative research strategy:

- The *Epidemic Risk Reduction and Value Capture Research and Development Program* supports research into impacts of the current infestation, and helps to develop ways to reduce risk of future infestations. This program also assists development of decision-support systems that will guide effective beetle management across western Canada.

In developing the research agenda, Natural Resources Canada committed to returning to the regional venues to update workshop participants on Initiative research activities and the beetle epidemic.

In 2003, Natural Resources Canada hosted a one-day forum in Kelowna, British Columbia, as part of the Entomological Society of Canada meetings, and a similar 'accountability forum' at the University of Northern British Columbia, in Prince George.

During the two years of program delivery, 68 First Nations and 147 private lands projects have been completed or are underway. With financial support from Natural Resources Canada, Parks Canada has implemented about 60 beetle-management projects in the Rocky Mountain national parks, the leading edge of the beetle infestation. Forest management in protected areas is typically contentious, Parks Canada has included a suite of projects to inform residents, neighbors, visitors and other stakeholders about beetle management activity, impacts and options under the Mountain Pine Beetle Initiative.

Under the research program, more than 75 collaborative projects to fill gaps in our knowledge about beetles and the ecological, economic and social impacts of the epidemic are active or completed. Projects are also delivering tools to reduce risk of future pest infestations. This research is delivered in cooperation with Canadian universities, national forestry research centres, provincial agencies and other research institutions. A sample of projects is highlighted in this report.

A top priority was to quantify the infestation status and determine the outlook for its spread. Projections using models developed with Initiative funding forecast that the infestation could expand to cover 10.2 million hectares in British Columbia and into Alberta and the boreal forest. Other models focus on how the infestation will affect different forest landscapes on a stand-by-stand basis. Work has been completed on the potential for use of remote sensing in monitoring pest outbreaks.

Given the large volume of dead timber, questions being examined include how to integrate beetle-killed timber, with its suite of problematic characteristics, into existing manufacturing processes and markets; the period during which dead timber remains useful for manufacturing; the potential of beetle-killed timber for biomass energy; the impact of the epidemic and salvaging on forest hydrology; how forests will regenerate after beetle attack, and; what the implications for fire hazard are.

Research that has been completed includes estimates of the economic impact of anticipate timber supply adjustments on communities in the epidemic area; how best to manage the salvage harvesting for non-timber values such as visual and wildlife objectives; what economic issues emerge from large-scale forest disturbances, and; an examination of future forest options.

The Mountain Pine Beetle Initiative continues to engage directly with sector stakeholders affected by the infestation in the identification of priority research questions. Increasingly, the examination of research needs includes work related to post-beetle policy responses to the ecological, economic and social legacies of the beetle epidemic.

This report highlights past delivery of the land-based programs and progress of beetle research during 2003 and 2004 by the Mountain Pine Beetle Initiative. Initiative information is posted at http://mpb.cfs.nrcan.gc.ca/index_e.html. We invite you to visit the website regularly to observe our progress.

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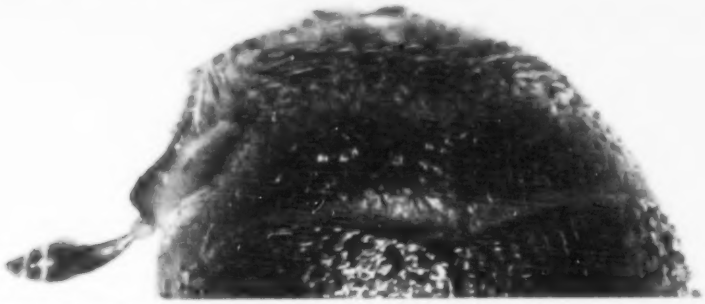
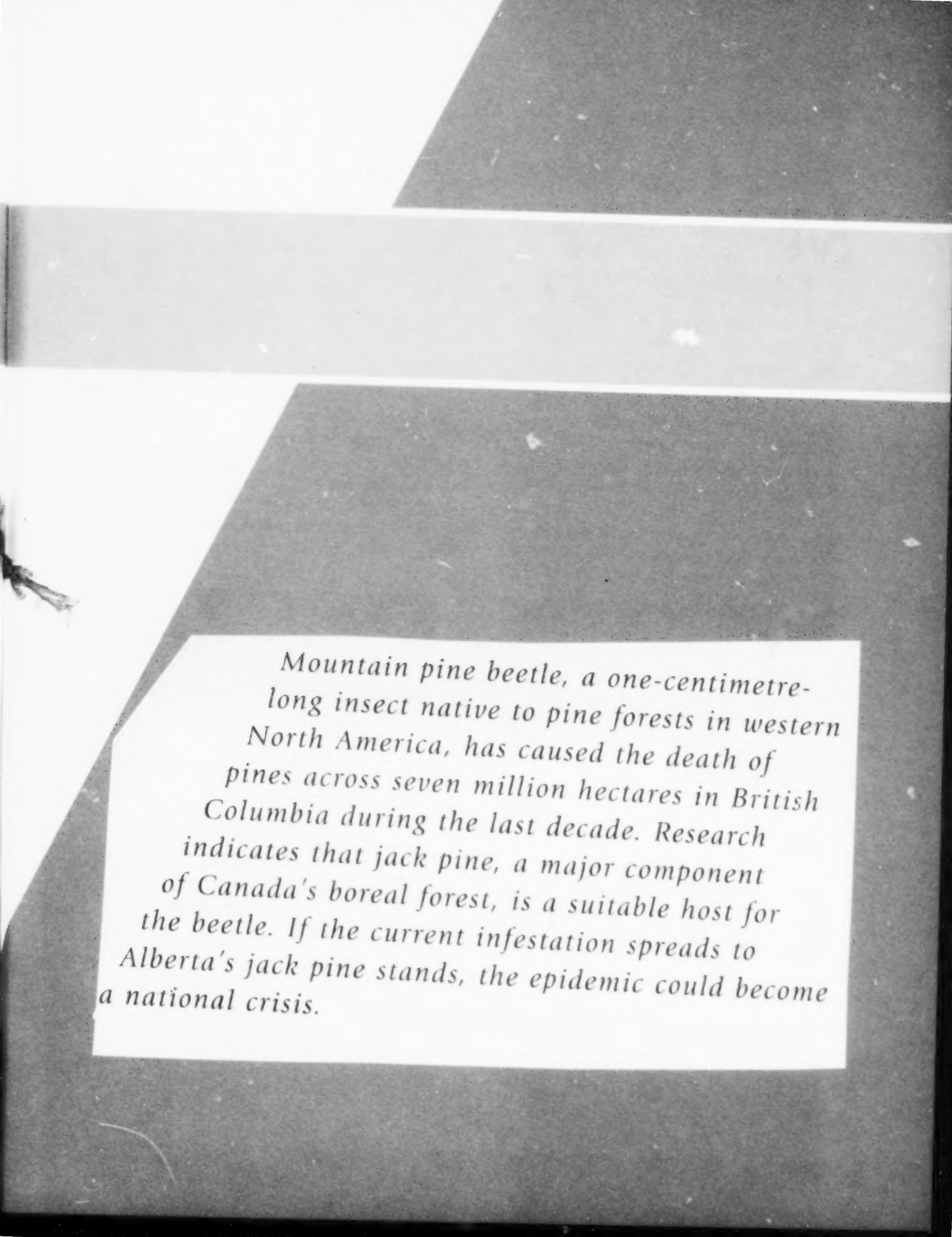


Introduction



Mountain pine beetle, a one-centimetre-long insect native to pine forests in western North America, has caused the death of pines across seven million hectares in British Columbia during the last decade. Research indicates that jack pine, a major component of Canada's boreal forest, is a suitable host for the beetle. If the current infestation spreads to Alberta's jack pine stands, the epidemic could become a national crisis.

Introduction

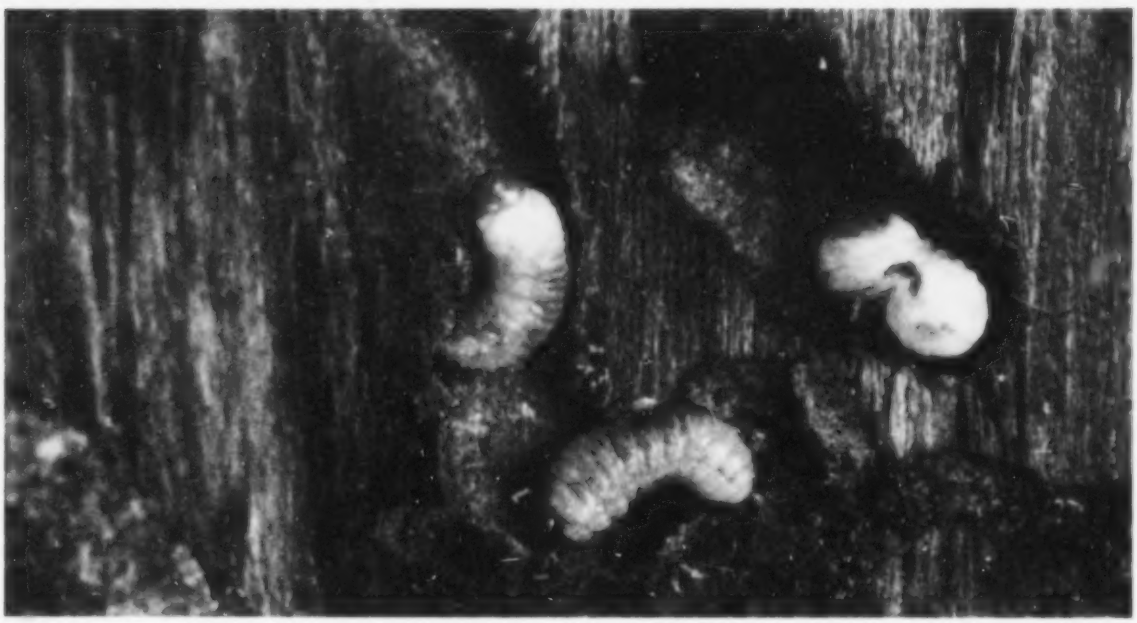
THE EPIDEMIC

Mountain pine beetle, ***Dendroctonus ponderosae***, is native to lodgepole pine forests of western North America. At endemic population levels, the insect attacks old and weakened trees, promoting generation of younger stands. Normally, cold winters, wildfire, and conditions found in natural, mixed-aged pine forests keep beetle populations low.

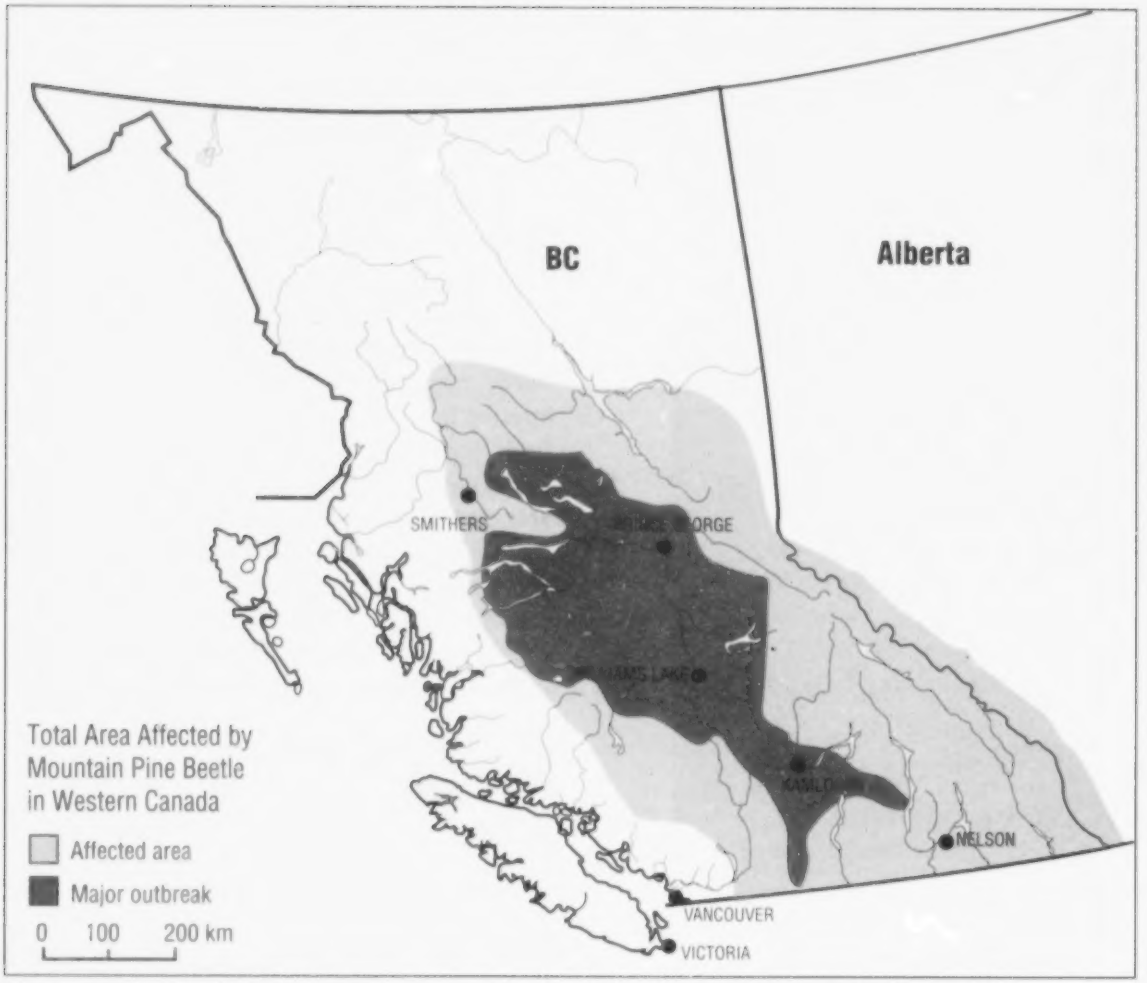
During outbreaks, mountain pine beetle becomes the most destructive insect pest of mature pine forests. The beetles selectively swarm pine trees aged 80 to 120 years old, overwhelm tree defences, and kill the trees. Since foresters began recording insect infestations in British Columbia in 1910, periodic outbreaks have been recorded, but none have been so severe or extensive as the epidemic British Columbia's forests experience today.

The current infestation was first identified in the mid-1990s in Tweedsmuir Provincial Park, British Columbia. Since then, consecutive mild winters, an abundant food source of mature pine trees, and the remoteness of many initial outbreak areas have allowed the beetle to proliferate. From an estimated area of 200,000 hectares in 1999, the epidemic has spread to an unprecedented seven million hectares in British Columbia in 2004.

In the prairie provinces, the beetle is currently confined to local outbreaks in the foothills and mountain valleys of western Alberta, from Waterton Lakes National Park in the south to the Wilmore Wilderness Area in the north, as well as in the Cypress Hills of southern Alberta and Saskatchewan. There are additional infestation hot spots in Washington, Idaho and Montana.



Mountain pine beetle attacks trees by laying eggs under the bark. When eggs hatch, the larvae cut the tree's supply of water and nutrients. The beetles also carry a fungus that inhibits a tree's defences against beetle attack. The fungus causes sapwood discolouration called blue stain.

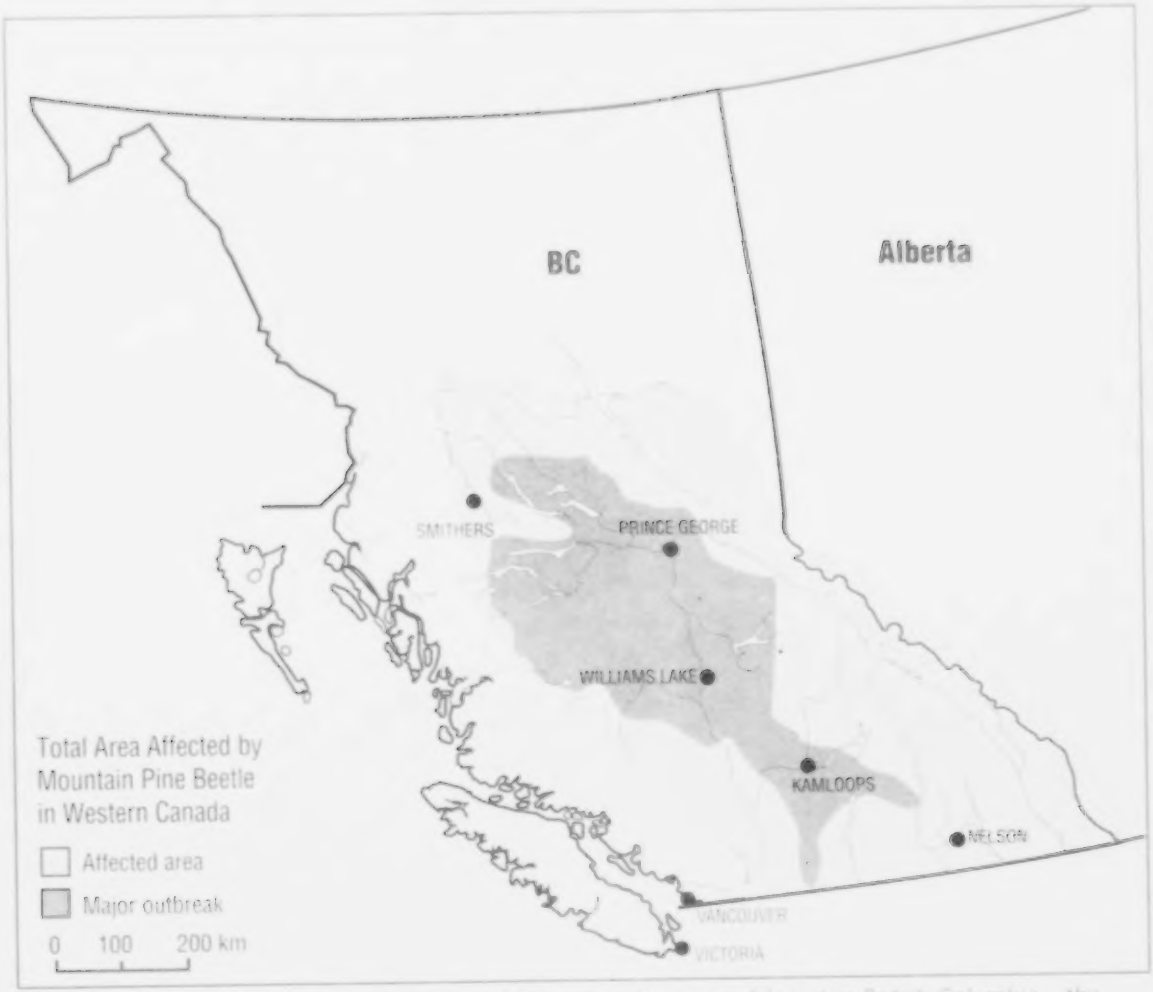


The current infestation may spread to cover 10.2 million hectares of forest in British Columbia—the province's entire land base of lodgepole pine forests. As well, infestation hot spots in Alberta are the target for direct control activity under the Mountain Pine Beetle Initiative.

THE IMPACT

The volume of beetle-killed timber in the province is estimated to be 250 million cubic metres—3.5 times the province's total annual allowable cut.

In order to help deal with the amount of dead standing beetle-killed timber, the Chief Forester for British Columbia increased in 2004 the annual allowable cut in beetle-infested timber supply areas by more than 12.7 million cubic metres—a 51 per cent increase above the then-determined long-term sustainable harvest. This increase initially benefits communities; however, the inevitable decrease in available harvestable timber, expected to occur within 10 to 15 years, may cause displacement within forest-dependent communities.



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Although the annual allowable cut for beetle-affected areas has been increased, by the time the infestation runs its course, it is estimated an additional 300 million cubic metres of beetle-killed timber will remain unsalvaged. The legacy of unused timber is a product of market constraints and of the rate of deterioration of processing and product-performance properties following tree death. Beetle-salvage timber differs significantly from green timber: salvage timber is desiccated, cracked, checked and blue stained. These changes in timber quality affect both manufacturing and markets.

The size and extent of the epidemic also has significant ecological ramifications. The loss of large proportions of tree cover across entire landscapes could impact wildlife and fisheries habitat, hydrological cycles, and soil health and stability. Large-scale salvaging operations could also affect the ecological integrity of forest landscapes.

THE RISK

If the current trend of mild winters and hot, dry summers continues in western Canada, the epidemic could spread throughout Alberta's lodgepole pine forests. Although the beetle's primary host is lodgepole pine, whitebark pine and limber pine have also been attacked in Alberta. Research indicates the beetle could infest jack pine, a major component of Canada's boreal forest, which extends from the Yukon to Atlantic Canada.

If the beetle epidemic spreads from lodgepole pine to jack pine, eastward expansion of the beetle's range will be dictated by, among other factors, incidence of cold weather events and reduced beetle survival in mixed-species stands of the boreal forest.

THE MOUNTAIN PINE BEETLE INITIATIVE

To help address the beetle epidemic, in October 2002, the Government of Canada announced the six-year, $40-million Mountain Pine Beetle Initiative. Through Natural Resources Canada, Canadian Forest Service, the Initiative supports research to study the impact of the current infestation and reduce the risk of future outbreaks, and provides technical and funding assistance for beetle management and rehabilitation of beetle-infested federal and private non-industrial forestlands. Initiative programs support the Canadian Forest Service's mandate to promote the sustainable development of Canada's forests and the competitiveness of the Canadian forest sector. This mandate includes science and technology, aboriginal affairs, national reporting, building consensus, international trade and relations, and the management of federal lands.

Objectives of the Mountain Pine Beetle Initiative

1. **to reduce the impact of the current beetle epidemic;**
2. **to reduce the risk of future beetle epidemics.**

The Mountain Pine Beetle Initiative is designed to complement provincial beetle-epidemic responses in both British Columbia and Alberta. Its objectives were drawn from a number of meetings and workshops held with forest research organizations, industry, provincial agencies, First Nations and other stakeholders to determine needs and priorities for research, development, control and rehabilitation.

The Initiative has two streams of programs to deal with the infestation. All programs are fully operating, and are delivered in cooperation with provincial agencies, federal departments and other stakeholders and participants.

1. Land-based Mountain Pine Beetle Initiative programs:

   - The Private Forestlands Rehabilitation Program provides financial and technical assistance on a cost-shared basis for private, non-industrial forestland owners affected by the beetle.

   - The Federal Forestlands Rehabilitation Program addresses harvesting and restoration of beetle-damaged stands that are federally managed, including First Nations forestlands, national parks, and other federal forestlands.

2. The Epidemic Risk Reduction and Value Capture Research and Development Program delivers research and focuses on the deployment and transfer of knowledge gained from beetle-related research.

The Mountain Pine Beetle Initiative consulted with stakeholders throughout 2002–2003 in order to determine the Initiative's needs, priorities and objectives. Stakeholders included:

- Apollo Forest Products Ltd.
- British Columbia Ministry of Forests
- British Columbia Ministry of Sustainable Resource Management
- British Columbia Ministry of Water, Air and Land Protection
- British Columbia Council of Forest Industries
- British Columbia non-industrial private landowners
- Canfor Corporation
- Caribou Lumber Manufacturers Association
- First Nations bands and organizations
- Forest Engineering Research Institute of Canada (FERIC)
- Forintek Canada Corporation
- FORREX
- Galloway Lumber Company Ltd.
- Gorman Bros. Lumber Ltd.
- Interior Lumber Manufacturers Association
- Kaleniskoff Lumber Co. Ltd.
- Lakeland Mills Ltd.
- Lignum Ltd.
- Municipalities in the beetle-infested zone
- National Fire Protection Association
- Nechako Lumber Company Ltd.
- Parks Canada
- Pope & Talbot, Inc.
- Pulp and Paper Research Institute of Canada (PAPRICAN)
- Riverside Forest Products Ltd
- Slocan Forest Products Ltd.
- The Pas Lumber Co. Ltd.
- Tolko Industries Ltd.
- Weldwood of Canada Ltd.
- West Fraser Timber Co. Ltd.
- Weyerhaeuser Canada Ltd

(Names may have changed since consultation due to industry mergers or acquisitions.)

Accomplishments: Land-based programs

Pine forests cover more than 10 million hectares of British Columbia's interior.

Photo credit: Yoho National Park, Parks Canada

Accomplishments: Land-based programs

Natural Resources Canada, Canadian Forest Service, manages two distinct land-based programs under the Mountain Pine Beetle Initiative: one is aimed at federal lands rehabilitation; the other focuses on rehabilitating private lands. Both programs work with stakeholders on a cost-shared basis.

The Private Forestlands Rehabilitation Program is designed to assist private landowners in early intervention efforts of beetle control and rehabilitation of forestlands damaged by the infestation. The program is specific to non-industrial private owners of forestlands 10 to 2,000 hectares in size. Management of the program is the responsibility of Natural Resources Canada.

The Federal Forestlands Rehabilitation Program focuses on federal lands with significant concentrations of beetle-infested forests. The program is jointly delivered with Parks Canada and in co-operation with Indian and Northern Affairs Canada and the Department of National Defence. Specifically, this program delivers a beetle management response on federal lands comprised of activities aimed at:

- First Nations reserve lands in beetle-infested areas;
- National parks in the Rocky Mountains of British Columbia and Alberta, and;
- The Chilcotin Military Reserve and Dominion Coal Blocks lands.

The program supports forest rehabilitation (harvesting and restoration activities) on federal lands, and works with First Nations to enhance capacity in beetle–forest management and rehabilitation. The First Nations element also works with bands to reduce beetle-caused forest fuel loads and fire risk to First Nations communities.

Because the Initiative's land-based programs are directed at land affected by the epidemic, site-specific conditions must be considered before beetle management prescriptions or rehabilitation treatments can be effectively implemented. Advance preparation, in the form of surveys and treatment strategies by experienced, forestry professionals, is required before beetle management activities are funded.

Both the Private Forestlands Program and the First Nations Element of the Mountain Pine Beetle Initiative are cost-shared programs, with private land owners and First Nations contributing a minimum of 20 per cent of total project costs.

Summary of Accomplishments

Since October, 2002, the Initiative has invested almost $2.25 million in 215 projects to assist private, non-industrial forestland owners and First Nations with lands affected by mountain pine beetle. Projects include surveys and treatments to control the infestation and restore infested forestlands. Private forestland and First Nation collaborators contributed more than $450,000 to the beetle management and rehabilitation efforts.

The Initiative provided a further $2.6 million to Parks Canada and other federal forestlands in the infestation zone to conduct 65 beetle management responses in forests in Rocky Mountain national parks, the Chilcotin Military Reserve and the Dominion Coal Blocks.

First Nations: $1,375,000.00
Parks: $2,400,000.00
Other Federal Forestlands: $180,000.00

Mountain Pine Beetle Initiative expenditures, per land-based program, to March, 2005

First Nations: 68
Parks: 60
Other Federal Forestlands: 5

Mountain Pine Beetle Initiative-funded beetle management and site rehabilitation projects, October, 2002 — March, 2005

Private Woodland Owners: 124
National Parks: 5
Other Federal Forestlands: 2

Number of agencies, organizations and individuals funded under Initiative land-based programs, to March, 2005

PRIVATE FORESTLANDS REHABILITATION PROGRAM

During its first two years, the Private Forestlands Rehabilitation Program has built a foundation of field-level information about the condition of these forestlands within the expanding beetle emergency management zone. This foundation is necessary for effective and efficient application of the program: risk reduction and rehabilitation treatment activities funded by the program are based on these assessments and surveys.

Surveys to assess local levels of infestation have been conducted, and strategic plans for beetle-infestation management and treatment are being implemented. The beetle emergency management zone, as established by the British Columbia Ministry of Forests, expands annually to encompass territories newly infested by the beetle. This expansion increases the number of private, non-industrial forestland owners eligible for assistance through the Mountain Pine Beetle Initiative, and likewise increases the number of sites to be surveyed and assessed for infestation.

Objectives of the Private Forestlands Rehabilitation Program
The objectives of the Private Forestlands Program are to assist owners of private, non-industrial forestlands within the mountain pine beetle emergency management zone to:

- Control and reduce spread of the beetle on private non-industrial forestlands;
- Rehabilitate private, non-industrial forestlands affected by the beetle; and,
- Enhance landowner understanding and knowledge of beetle control and sustainable forest management.

Program information tools, such as *Mountain Pine Beetle Initiative Private Forestlands Rehabilitation Program Application Guidelines*, *Mountain Pine Beetle Management: A guide for small woodland operations*, as well as fact sheets and information pamphlets are available to inform landowners with stands at risk. Canadian Forest Service forestry liaison officers, and program officers provide information about the program and about possible beetle control and management activities. They conducted initial infestation assessments, attended meetings with landowners, held town-hall community awareness and information sessions and took part in media interviews and other opportunities to inform landowners about the program and the beetle.

Summary of Accomplishments

To date, the program has invested $870,000 in financial and technical assistance to 124 private, non-industrial forestland owners affected by the beetle to help manage and rehabilitate affected forestlands. One hundred and forty-seven beetle control and site rehabilitation projects have been completed or are underway. New sites and projects are approved weekly as landowners with infested forestlands apply.

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Program Highlight

BEETLE PROJECT HELPS CONTROL INFESTATION IN RANCH'S FORESTS

For many years, mountain pine beetle has infested scattered portions of the Double Diamond Furlong Holdings Inc., a large ranch with 370 hectares of forest, located near 150 Mile House, British Columbia. The attack is intensifying. From two green-attack trees felled and burned in 2001, the number of attacked trees grew to 14 truckloads removed and a volume of immature, non-merchantable, timber felled and burned in 2003. Ground surveys indicate that almost all of the pine on the property has been, or will be, attacked by the end of beetle flight in 2005.

The current project (2004/2005), funded by the Mountain Pine Beetle Initiative, continues the property's long-term forest management plan. Under the project, the entire property will be surveyed, and trees marked and laid out for either sanitation harvesting or fall and burn of non-merchantable, immature stems. Approximately 75 trees will be debarked for use as fence logs. The landowners, with assistance from a forestry professional, will conduct the harvesting and a portion of the fall and burn and debarking treatments.

Although work undertaken will help control the infestation on the ranch, it is expected more treatment prescriptions, site preparation and reforestation will be required in the future, until either the beetle epidemic ends or no beetle-susceptible lodgepole pine remains on the property.

Contact: Mervyn Furlong
Double Diamond Furlong Holdings Inc.
150 Mile House, British Columbia
Telephone: 250.276.4460
E-mail: furlong@telus.net

Presence of mountain pine beetle is confirmed by stripping samples of bark from a suspect tree.

Program Highlight

PRINCETON RANCH ADDRESSES CURRENT BEETLE ATTACK AND SUSCEPTIBLE STANDS

For three years, the owners of the Rafter F Ranch, located 10 kilometres northeast of Princeton, British Columbia, have been felling and burning mountain pine beetle-infested ponderosa pines throughout the ranch and on adjacent leased Crown land.

In April 2004, the Mountain Pine Beetle Initiative helped fund an aerial survey of infestation on the 586-hectare ranch and surrounding three-kilometre buffer. The owner and a forest-health consultant also conducted a ground assessment. From these surveys, a beetle management strategy was prepared that divides the property into three sections for beetle management, and provides both short- and long-term assessment and treatment measures for each section.

Infested timber is burned to control spread of the beetle to healthy trees.

Following the 2004 surveys, 35 beetle-infested ponderosa pine on the ranch property were felled and burned. The ranch's beetle management strategy plan recommends that ground surveys be conducted every fall to assess and allow time to effectively implement treatments, and to update the strategy as the infestation spreads throughout the property's pine forests.

Contact: David Eccott
Rafter F Ranch
Princeton, British Columbia
Telephone: 250.295.7268

FEDERAL FORESTLANDS REHABILITATION PROGRAM– FIRST NATIONS ELEMENT

The Mountain Pine Beetle Initiative Federal Forestlands Rehabilitation Program, First Nations Element provides First Nations bands with financial and technical assistance in planning, management, and control efforts associated with the beetle epidemic in the infestation area. The program's objectives are to support First Nations in early beetle-infestation control efforts and rehabilitation of infested reserve forestlands. The program is part of Natural Resources Canada, Canadian Forest Service's commitment to assist First Nations in management of reserve forestlands, and is the responsibility of Natural Resources Canada, Canadian Forest Service, with support from a technical advisory committee with representatives from First Nations, the Canadian Forest Service, and Indian and Northern Affairs Canada.

The Federal Forestlands Program enhances First Nations capacity in beetle management, and promotes band involvement in beetle management and rehabilitation efforts.

Program officers and field staff for the First Nations Element of the Initiative's Federal Forestlands Program have built a foundation of field-level information about the condition of lodgepole pine-forested reserve lands within the expanding beetle-infestation zone. When the Initiative started in 2002, 75 First Nations in British

Objectives of the First Nations Element
The objectives of the program are to:

- Assist First Nations to control and reduce the spread of mountain pine beetle on reserve forestlands; and,
- Assist First Nations to restore and rehabilitate reserve forestlands affected by the beetle, and to reduce post-beetle forest fuel levels.

The program also assists First Nations to:

- Enhance capacity in beetle management and control; and,
- Promote involvement in beetle forest management and rehabilitation efforts.

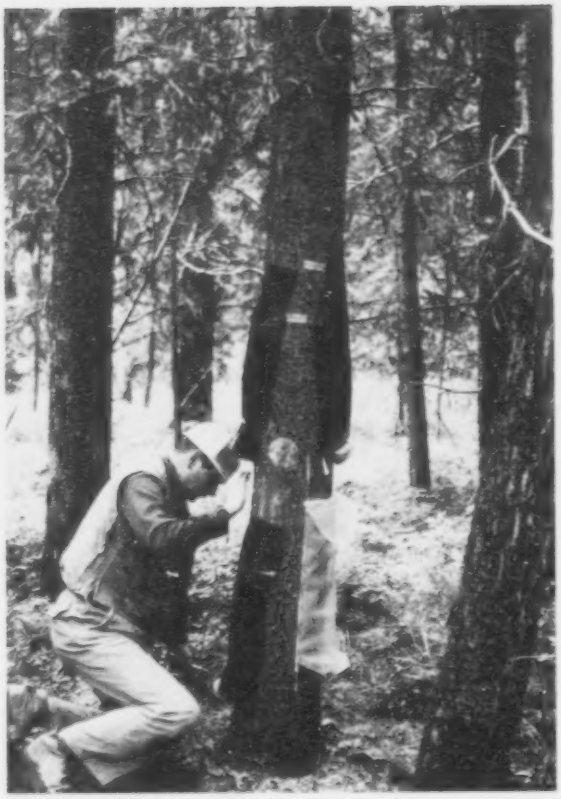
Columbia had forestlands within the beetle-infestation zone. As of the end of 2004, the infestation encompassed forested reserve lands of 108 First Nations in British Columbia.

In addition to beetle suppression, salvage, and monitoring activities eligible for funding under the Federal Forestlands Program, the First Nations Element was adjusted in late-2004 to include fuel management of beetle-killed stands around First Nations communities. Beetle-related forest fuel management projects have been initiated with 12 eligible First Nations.

Through the Initiative, First Nations members are able to enhance their understanding and knowledge of sustainable forest management. By working closely with forestry professionals, members of First Nations bands build capacity about the beetle, signs of infestation, insect surveys, and forestry.

Summary of Accomplishments

Since the start of the Mountain Pine Beetle Initiative, 57 First Nations bands and organizations in British Columbia and Alberta with beetle-affected forestlands have received financial and technical assistance to help control, manage and rehabilitate infested forestlands. A total of 68 projects, including surveys, rehabilitation strategy plans and treatments, were funded. A number of these projects are designed to reduce wildfire threat to First Nations communities. Participating bands are located throughout the beetle emergency management zone. Funds dispersed to date through this element of the Federal Forestlands Program total $1.375 million.



Pheromone baiting can keep a light infestation from intensifying. The pheromone attracts beetles to baited trees, which are then felled and burned.

Program Highlight

FIRST NATIONS ELEMENT FOREST FUEL MANAGEMENT ACTIVITY

In the fall of 2004, a First Nations consultant on contract with the Canadian Forest Service surveyed and identified 12 First Nations within the mountain pine beetle emergency management zone to determine interest in participating in forest fuel-management activities under the Mountain Pine Beetle Initiative. The consultant assisted those communities in applying for project funding. Each First Nations received a guidebook containing Mountain Pine Beetle Initiative forest fuel management activity guidelines and an application form, along with a table summarizing the data required to demonstrate eligibility and develop treatment recommendations.

After reviewing the guidebook with each First Nation, field assessments were conducted to determine the size and location of each community core, community values, and the effects of the beetle on the reserve forestlands, and to recommend treatments and activities suitable for each community and site.

Contact: Nello Cataldo
Canadian Forest Service
Pacific Forestry Centre
E-mail: ncataldo@pfc.cfs.nrcan.gc.ca

The Mountain Pine Beetle Initiative is working with First Nations to reduce post-beetle increases in forest fuel loads around First Nations communities.

Program Highlight

ESKETEMC FIRST NATION DOES ITS PART TO MANAGE BEETLE EPIDEMIC

The 2004 Esketemc project represents about $60,000 from the First Nations Element of the Mountain Pine Beetle Initiative, plus $215,000 from the band, an unusually high band contribution for a beetle management plan.

"We started surveying last year, and did some more this spring," says Bill Young, a consulting forester with the Esketemc First Nation. "Now we've assessed all 18 parcels of land that comprise Esketemc reserves." Esketemc First Nation is located about 50 kilometres south of Williams Lake, British Columbia, in the Fraser River drainage.

In many projects funded under the First Nations Elements, band members are hired to help survey infested forestlands and implement treatments.

The Esketemc draw on band members to do much of the work to implement a beetle management plan for 2,700 hectares. Six Esketemc worked on the surveys. Eight band members worked on logging beetle-infested trees.

West Fraser Timber, Riverside Forest Products, and S&P Lumber—all located in Williams Lake—have expressed interest in buying wood harvested on Esketemc land.

The Esketemc First Nation is planning to implement widespread reforestation as part of its beetle management plan. In addition, the Nation is exploring ways to combine forest fire-risk management with beetle treatment measures.

Contact:
Irene Sure, Forestry Manager
Esketemc Indian Band
Williams Lake, British Columbia
Telephone: 250.440.5870

FEDERAL FORESTLANDS REHABILITATION PROGRAM– NATIONAL PARKS ELEMENT

The National Parks Element of the Mountain Pine Beetle Initiative's Federal Forestlands Program focuses on delivery of beetle management efforts in the Rocky Mountain federal parks in Alberta and British Columbia, and helps fulfill the Government of Canada's responsibility toward these federally managed lands. The program's primary objectives are identification and monitoring of infestation hot spots, beetle management demonstration sites and public information, sanitation harvesting, and development and application of beetle-risk management models that take into consideration the parks' ecological mandates. Beetle population growth in national parks is of significant concern to Alberta government agencies, forest communities and the forest industry, because of the high proportion of lodgepole pine in the province's timber inventory. In addition, infested stands within the parks are a potential corridor to susceptible jack pine stands in the boreal forest.

Since the start of the program in October, 2002, Parks Canada has established a senior-level Strategic Direction Council to provide leadership and coordinate efforts regarding response to mountain pine beetle in the Rocky Mountain national parks, and has consulted with residents, neighbours, visitors and other stakeholders. Outreach education and communications programs have been implemented to educate park visitors about the beetle and about the roles of prescribed fire and natural disturbance in maintaining the parks' ecological integrity.

Coordinated efforts using ecosystem-based management approaches to forest health have mitigated expansion of beetle populations in the Rocky Mountain national parks, resulting in reduction of short-term risk to the commercial forests in Alberta. The parks have implemented regional management strategies based on the use of prescribed fire. Park-specific strategic plans indicate where active control will take place; such controls include a combination of prescribed burning, pheromone baiting and limited cutting, and where beetle populations will be monitored. Benefits include reducing beetle populations and habitat, renewing forest health, improving wildlife habitat, reducing susceptibility to wildfire and future insect and disease infestations, and providing effective management of public lands for future generations. Control efforts are complemented by intensive monitoring within and near park boundaries by the Canadian Forest Service,

Parks Canada's policy provides the following direction to national parks affected by mountain pine beetle:

- **Native insects and diseases are natural ecological processes that should be allowed to proceed without interference if possible.**
- **Prescribed fire areas where pine forests will be burned to reduce the extent of mature pine and thus prevent a large build-up of the beetle population.**

Canada's national parks situated in Alberta along the Rocky Mountains are at the front lines of the current beetle epidemic. Photo credit: Yoho National Park, Parks Canada

Parks Canada and Alberta Sustainable Resource Development. Parks Canada staff are also collaborating on beetle-related research under the Initiative's Epidemic Risk Reduction and Value Capture Research and Development Program.

Summary of Accomplishments

With more than $2.4 million in financial assistance from the Mountain Pine Beetle Initiative, as well as technical assistance from the Canadian Forest Service, Alberta Sustainable Resource Development and the British Columbia Ministry of Forests, Rocky Mountain national parks affected by mountain pine beetle have responded to the beetle threat with an aggressive program of beetle monitoring, mapping and direct control. The program is complemented by communications with residents, neighbors, visitors and other stakeholders. Parks Canada's response to the threat of major infestation by the beetle encompasses the agency's mandates for long-term ecological protection, public consultation and education regarding the beetle and the role of prescribed fire in balancing ecological and social requirements. About 60 beetle-related projects in the five Rocky Mountain national parks have been made possible with Initiative funding since 2002.

Program Highlight

HOODOO CREEK FIRE PROTECTION AND ECOSYSTEM RESTORATION

In Yoho National Park, the most active populations of mountain pine beetle are concentrated at the west end of the park, in the Kicking Horse Valley. Although the insect has been present in the park since the 1930s, recent surveys conducted as part of the Mountain Pine Beetle Initiative indicate local beetle populations are growing rapidly. This growth is made obvious by the large areas of red trees seen from the highway at the west end of the park.

In the winter of 2004–2005, an area near the park's Hoodoo Creek campground was thinned to create a fireguard. The guard facilitated the Hoodoo Creek prescribed burn in the spring and kept the burn within planned fire boundaries. The prescribed burn of the forested area at the southwestern boundary of the park was planned in order to meet ecological goals, help contain the beetle and reduce risk of wildfire. The burn area is approximately nine kilometres long, and begins two kilometres north of the campground. Total area burned covers just over 2,000 hectares.

The Hoodoo Creek prescribed burn will create diversity on the landscape—variations in tree species, ages and structure—that nurtures a healthy forest. The burn is also helping to slow the spread of the beetle by eliminating infested trees.

Contact: Dave Dalman
Parks Canada
Banff National Park
Banff, Alberta
E-mail: dave.dalman@pc.gc.ca

Prescribed burns are part of Parks Canada's beetle management strategies under the Mountain Pine Beetle Initiative. One objective of the burn activity is to reduce the spread of the beetle into Alberta and boreal pine stands.

Program Highlight

BEETLE CONTROL IN BANFF NATIONAL PARK

To achieve the objectives outlined in Parks Canada's policy on mountain pine beetle, Banff National Park has established three strategic management zones:

1. A non-intervention zone west of Banff townsite in which beetle populations are monitored;

2. A prescribed fire zone in which pine forests will be burned to reduce the extent of mature pine, and thus prevent a large build-up of the beetle population, and;

3. Areas of prescribed burning, pheromone baiting and limited cutting in which trees being attacked are burned by prescribed fire, cut and removed, or cut and burned in order to slow beetle population increase.

Selective falling and burning of infested trees are helping park managers control the current beetle epidemic in Banff National Park.

Since the winter of 2002, several actions have been taken in the prescribed burn, pheromone baiting and cutting zone: 2,725 individual beetle-attacked trees were cut and burned; the Fairholme prescribed burn removed 4,420 hectares of beetle habitat and beetle-attacked trees; research was begun to determine if partially scorched trees in some areas of the recently burned Fairholme reduce the survival and reproductive rate of beetles compared to areas that haven't been burned; 524 pheromone baits were set up to concentrate beetle attack to known areas. When the baits were surveyed, 950 trees were found to have been colonized. By late 2004, 450 of the colonized trees were hand felled and burned; the remaining colonized trees were removed mechanically during the winter.

Contact: Dave Dalman
Parks Canada
Banff National Park
Banff, Alberta
E-mail: dave.dalman@pc.gc.ca

FEDERAL FORESTLANDS REHABILITATION PROGRAM–OTHER FEDERAL FORESTLANDS ELEMENT

This element of the Federal Forestlands Rehabilitation Program focuses on inventorying at-risk forest areas, planning beetle management strategies, conducting sanitation harvesting and rehabilitating beetle-damaged stands in Chilcotin Military Reserve and Dominion Coal Blocks lands. Work undertaken builds on a collaboration between Natural Resources Canada and the Department of National Defence, First Nations and industry. To date, inventory and forest management plans have been completed or are underway on the forestlands.

The Chilcotin Military Reserve is a 40,960-hectare tract west of Williams Lake, British Columbia, under the jurisdiction and authority of the Department of National Defence. The property, also known as the Chilcotin Training Area, is administered by Area Support Unit Chilliwack, which uses the property periodically for military training and manoeuvres. Large-scale infestations of mountain pine beetle and Douglas-fir beetle are occurring on the property.

The Dominion Coal Blocks consist of two properties of about 20,000 hectares each, near Fernie, British Columbia. The properties are under the jurisdiction and authority of Natural Resources Canada, and are reserved primarily for its coal resources. The British Columbia Ministry of Forests has an agreement with Natural Resources Canada for managing forest resources on the Dominion Coal Blocks. Also, the Ktunaxa–Kinbasket Tribal Council has treaty interests in the properties; the provincial government has awarded the tribal council a Community Forest License Pilot Agreement tenure covering all of the Dominion Coal Blocks. The Ktunaxa–Kinbasket nation is a key player in all Initiative-funded work in Dominion Coal Blocks forests.

Summary of Accomplishments

During the first two years of the Initiative, beetle management strategy plans were completed for the Dominion Coal Blocks and Chilcotin Military Reserve federal forestlands with First Nations participation. Surveys and treatment prescriptions were carried out, identifying control and site rehabilitation priorities. The Mountain Pine Beetle Initiative has invested $184,000 on beetle planning and control activities on both properties.

Mountain pine beetle is active on the Chilcotin Military Reserve and Dominion Coal Blocks, which together account for almost 80,000 hectares of mostly lodgepole pine forest in British Columbia.

Program Highlight

BEETLE SURVEYS CONDUCTED FOR MILITARY RESERVE FORESTS

The Mountain Pine Beetle Initiative provided funding in 2003 for contractor Cascadia Natural Resource Consultants Inc., of Kamloops, to prepare a management strategy to reduce mountain pine beetle impact in the Chilcotin Military Reserve's forests. The resulting strategy plan covers a five-year period (2004 to 2009), and outlines recommended management actions in an aggressive approach to the beetle problem. Among proposed actions are pheromone baiting, site rehabilitation and salvage harvesting. Also proposed is an annual aerial and ground detection program to identify and record the location, severity and movement of the infestation through the forest.

In the fall of 2004, funding from the Initiative was used to contract Terrasaurus Aerial Photography Ltd., of Vancouver, to carry out an aerial survey of the military reserve using high-resolution imagery (40-centimetre pixels). The photographs were processed into orthorectified mosaics, which were then analyzed for red-attacked trees. The resulting orthophoto images and beetle analysis have provided information that is being used to better define areas selected for potential treatments and ground surveys.

The Initiative has provided almost $50,000 towards beetle management and site rehabilitation projects on the reserve.

Contact: Nello Cataldo
Canadian Forest Service
Pacific Forestry Centre
Victoria, BC
E-mail: ncataldo@pfc.cfs.nrcan.gc.ca

Program Highlight

MANAGING BEETLES ON THE DOMINION COAL BLOCKS

The goals of Mountain Pine Beetle Initiative-funded projects on the Dominion Coal Blocks include conducting forest health inventories and assessments, preparing standard forest health management prescriptions and implementing prescriptions consistent with the Dominion Coal Blocks–Community Forest License Pilot Agreement Forest Management and Stewardship plans. Activities are similar to those funded under the First Nations Element, and include development and subsequent updating of a beetle management strategy and report for the property.

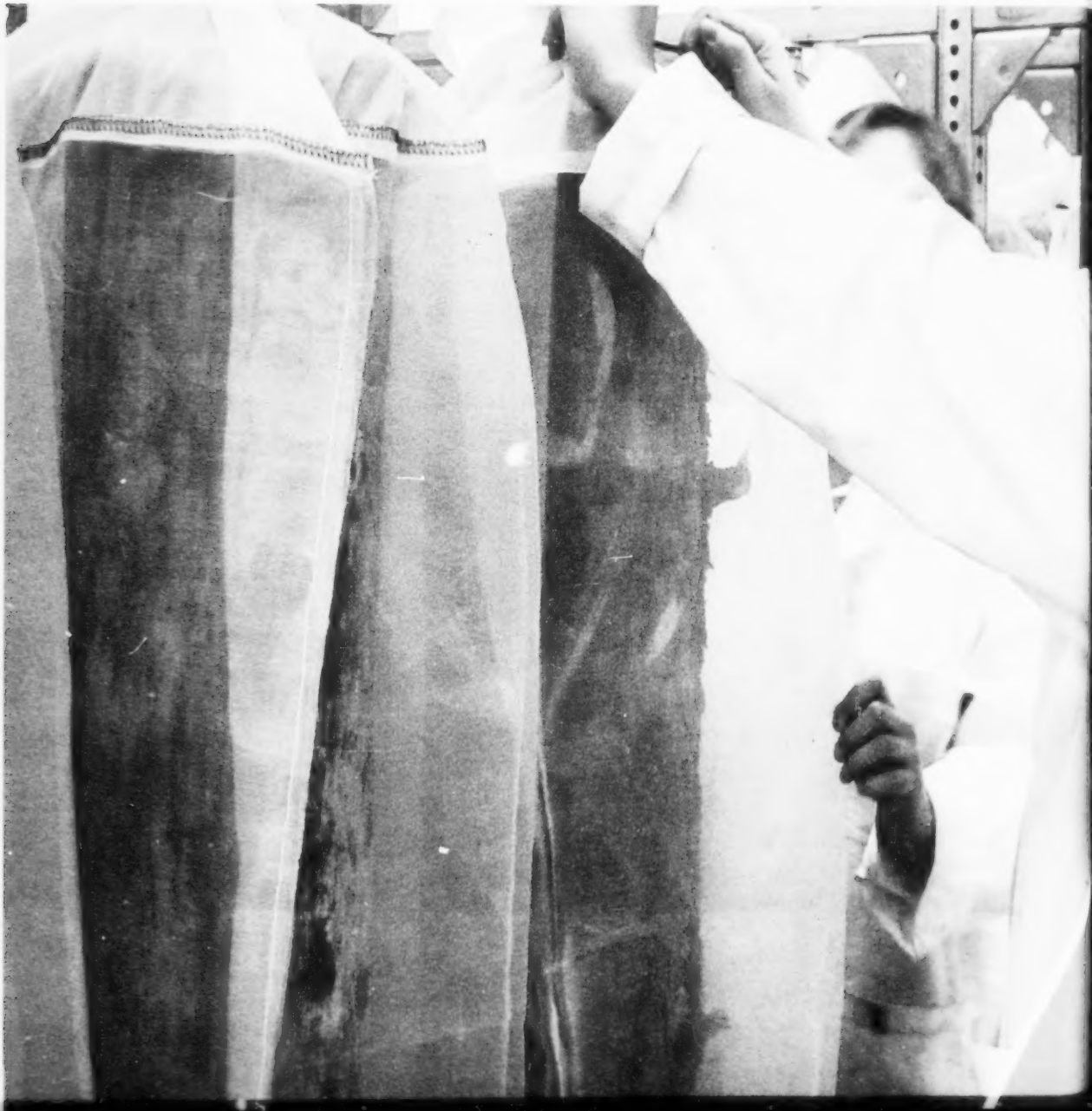
In 2003, the Initiative provided $60,000 for the Ktunaxa–Kinbasket Tribal Council and forestry consultant Interior Reforestation Co. Ltd., of Cranbrook, to work with the British Columbia Ministry of Forest and Tembec Forest Industries Ltd. to develop a beetle management strategy report for the property.

During 2004, a contract for $75,000 was awarded to the tribal council to complete forest health inventories and assessments, prepare standard forest health management prescriptions and implement prescriptions consistent with the forest management and stewardship plans. Activities included completion of ground surveys and treatment prescriptions on 1,593 hectares of forest land, plans for cutting strategies, and block identification. About 30 hectares of beetle-attacked timber identified in survey assessments were harvested under the tribal council's community forest agreement.

Contact: Nello Cataldo
Canadian Forest Service
Pacific Forestry Centre
Victoria, BC
E-mail: ncataldo@pfc.cfs.nrcan.gc.ca

About 30 hectares of beetle-attacked trees on the Dominion Coal Blocks have been harvested by First Nations.

Accomplishments: Research and development program

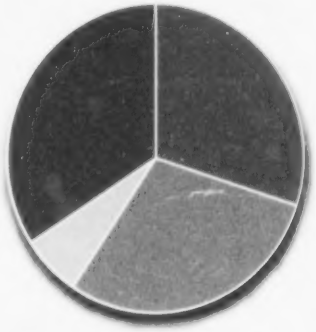


Due to the scale of the current beetle epidemic, major ecological, economic and social impacts are inevitable. The Mountain Pine Beetle Initiative is funding research and development to determine what the impact may be and ways to mitigate them.

Accomplishments: research and development program

The current mountain pine beetle epidemic in British Columbia is of record proportions. Recent mild winters, fire suppression and the remoteness of many initially attacked areas have allowed the beetle to thrive. The Chief Forester for the Province of British Columbia predicts that all 10.2 million hectares of the province's lodgepole pine forests may eventually be infested.

The epidemic and the factors contributing to it are overwhelming all direct control efforts except those at isolated hot spots. Because of the infestation's scale, major ecological, economic and social impacts from the epidemic are inevitable. Although many of the impacts cannot be eliminated, some can be mitigated. The objectives of the Epidemic Risk Reduction and Value Capture Research and Development Program are to reduce ecological, economic and social adjustment costs by analysing potential impacts and options of the current epidemic, and to reduce risk of future outbreaks. Research and knowledge acquisition and deployment are key.



Ecology: $1.63 million
Economics: $1.60 million
Social: $0.80 million
Risk Reduction: $1.85 million

Mountain Pine Beetle Initiative Research and Development Program funding, to March, 2005

In order to determine limits of current knowledge about the beetle, the Mountain Pine Beetle Initiative hosted a series of regional scoping sessions in collaboration with the British Columbia Ministry of Forests. Participants included First Nations, forestland managers and planners, government regulators and policy-makers, and forest-product manufacturers. About 150 forest-sector stakeholders participated in a series of regional forums to inventory project titles based on identified information needs to effectively respond to the beetle epidemic. These were then

Mountain Pine Beetle Initiative research and development priorities:

- Ecological research: Contribute to improved ecological integrity of post-beetle forest landscapes.
- Economic research: Provide information to complement harvesting and production decisions and to maintain markets for manufactured products from post-beetle timber.
- Social research: Provide analyses and information to assist the provinces and communities in the post-beetle transition.
- Risk Reduction: Provide decision-support systems that combine resource inventories and information management with scientifically credible forecasting models to reduce the risk of future large-scale epidemics.

returned to forum participants, who were asked to prioritize the titles. The resulting top priorities became the foundation for the development of the Epidemic Risk Reduction and Value Capture Research and Development Strategy, released in April, 2004.

Summary of Accomplishments

Since its inception, Epidemic Risk Reduction and Value Capture Research and Development Program has funded scientists and technicians from 15 research agencies, universities, and government agencies to conduct research on 75 projects. To date, the Initiative has published 35 research papers, and researchers have taken part in more than 110 workshops and conferences to present their work to fellow scientists, First Nations, policy makers and the public.

Research underway and supported by the Mountain Pine Beetle Initiative focuses on epidemic dynamics such as detection, mapping, and outbreak prediction, as well as post-beetle forest regeneration and forest management options to reduce infestation risk. Scientists receiving Initiative funding are also examining the impacts of changing timber supply on communities, forest ecology impacts and responses, impacts on established products and markets for increased use of beetle-killed timber, and factors influencing the shelf-life—or merchantability timeframe—for salvaged beetle-killed timber.

All research proposals submitted for initiative funding are assessed by a committee of research peers from government, industry and research against basic objectives established for the Mountain Pine Beetle Initiative. The review panels consist of representatives from:

- British Columbia Council of Forest Industries
- British Columbia Ministry of Forests
- British Columbia Ministry of Water, Lands and Air Protection
- Canfor Corporation
- Forest Engineering Research Institute of Canada (FERIC)
- Forintek Canada Corporation
- Lignum Ltd.
- National Fire Protection Association
- Natural Resources Canada, Canadian Forest Service
- Pulp and Paper Research Institute of Canada (PAPRICAN)
- Riverside Forest Products Ltd.
- Slocan Forest Products Ltd.
- Tolko Industries Ltd.
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Ecological research and development

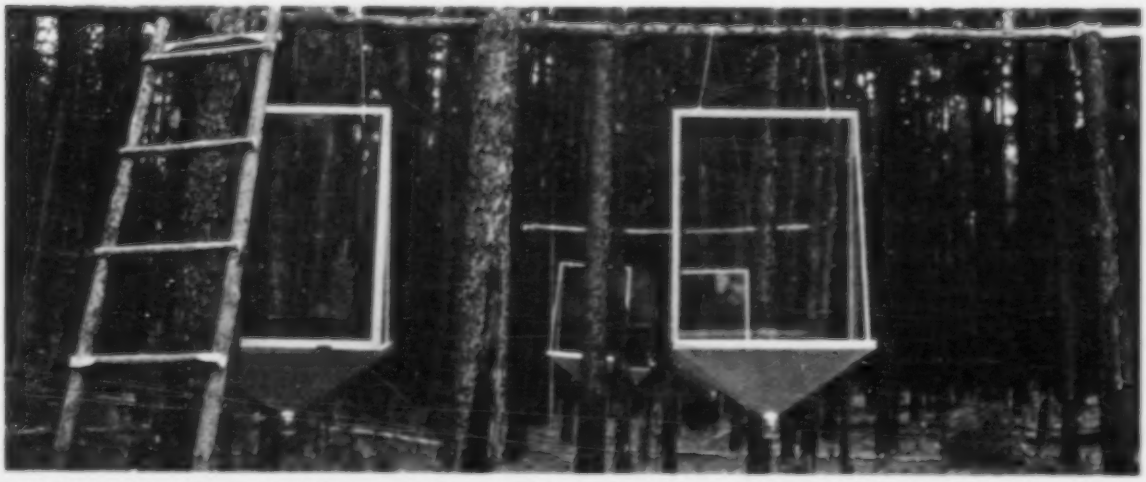
To define the scale of impact the current beetle outbreak could have on the province's forests, a projection model was developed in collaboration with the British Columbia Ministry of Forests. The model links the extent of susceptible lodgepole pine stands within the province to Mountain Pine Beetle Initiative-supported geographic spread models. The models are based on research by Canadian Forest Service and university entomologists which ascertained historic fluctuations in range of climate conditions and beetle outbreaks.

The results of the projection models indicate that the entire mature lodgepole pine resource in the British Columbia interior is at risk. Current estimates suggest that up to 600 million cubic metres of timber may ultimately be lost to the beetle across 10.2 million hectares of beetle-infested forest.

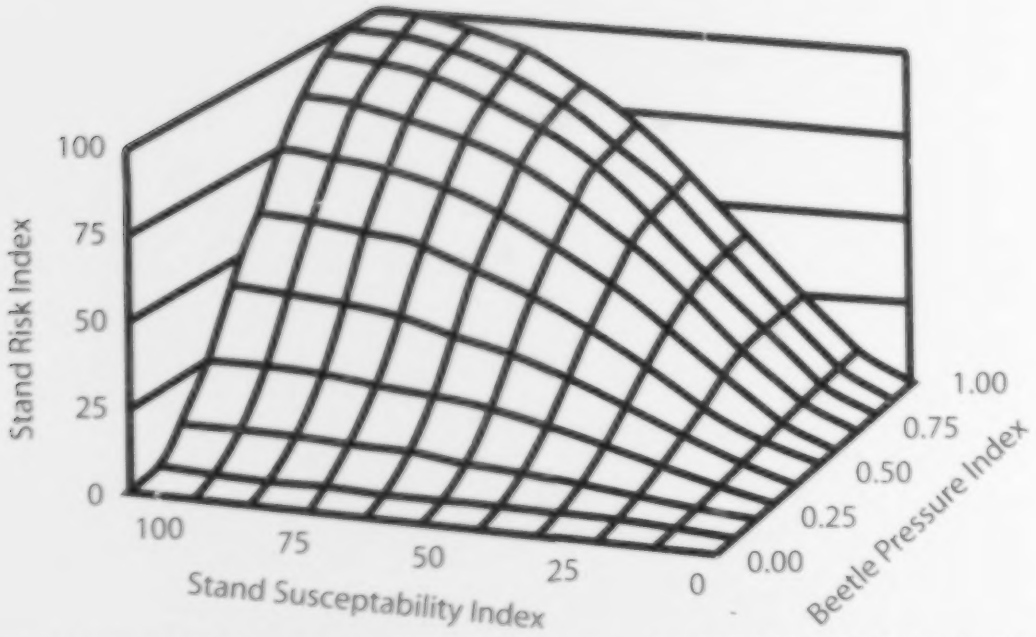
Ecological Strategic Objective: Contribute to improved ecological integrity of post-beetle forest landscapes.

conditions that trigger massive outbreaks among endemic populations. The models also draw upon Initiative research being carried out by Natural Resources Canada and university climatologists to assimilate the effects of climate change and global warming on forest susceptibility to the beetle across western Canada. The models are grounded in Initiative-supported studies being prepared by Canadian Forest Service researchers that use dendrochronological records established in annual growth rings of trees to examine

The severity of the epidemic has precipitated a significant increase in annual allowable cut in British Columbia to allow timely salvage of beetle-damaged timber. The increase is meant to capture projected volume losses due to mortality within heavily impacted stands, and reflect a dramatic shift in beetle management emphasis from active suppression to aggressive salvage. Large-scale salvage logging operations will recover a portion of potential revenue lost as trees die and deteriorate.



Field tests provide much of the raw data on which models being developed under the Mountain Pine Beetle Initiative's Research and Development Program are based.



Projection models which help map the risk of infestation spread are based on research in entomology, climate, forest stand dynamics and other factors influencing susceptibility and risk.

Salvage operations will create two classes of lands across the beetle-infestation zone: salvaged areas and unsalvaged areas. The impact of large-scale salvage logging will differ from the impact of normal harvesting operations. Changes in rate of harvest, size of harvest block, location of harvest block and intensity of regeneration will alter the ecological integrity of forest landscapes. Large unsalvaged areas will also differ from normal conditions, and will have a number of environmental risks and opportunities specific to large expanses of dead and dying forests. Unsalvaged timber in beetle-killed areas will increase amounts of sustainable management elements, such as snags and downed wood, often found in short supply across managed landscapes.

The Initiative supports research to quantify potential effects these alternative actions will have on timber and non-timber values associated with sustainable forest management. The Initiative is working with forestland managers and university researchers to evaluate effects of large-scale salvage logging on the sustained and widespread distribution of critical wildlife habitat elements and structures through time. The research is helping resource managers determine the manner and extent to which salvage logging should be implemented in order to balance economic and ecological considerations.

Similar models are being developed to determine the ecological legacies of unsalvaged post-beetle stands. A group of provincial and Canadian Forest Service researchers are assessing the forest fuel hazard that results from increased fuel loading in unsalvaged beetle-killed stands. Quantitative models of fire behaviour and effects (rates of spread, head fire intensity, spotting potential, ignition risk and vegetative effects of fire)

Large-scale salvage logging will create two classes of lands across the beetle-infestation zone: salvaged areas and unsalvaged areas.

to be developed for this fire complex are needed by fire managers to protect existing capital resources and communities, and to enable resource managers to better use fire to rehabilitate beetle-killed stands.

In a related study, university researchers are working to increase understanding of seedling regeneration after natural disturbance by the beetle. Natural regeneration patterns following infestation and wildfire are being compared to regeneration following salvage logging and prescribed burning. Insights from this project will aid in establishing treatment guidelines to maximize seedling regeneration.

Another team of Canadian Forest Service soil scientists and provincial hydrologists is working to investigate and model the influence of the beetle infestation on the hydrologic processes of British Columbia interior watersheds through detailed assessment of surface drainage patterns and water-table elevation. This landscape-level change has ecological consequences as well as significant economic consequences for forest companies and forest-dependent communities in British Columbia and Alberta.

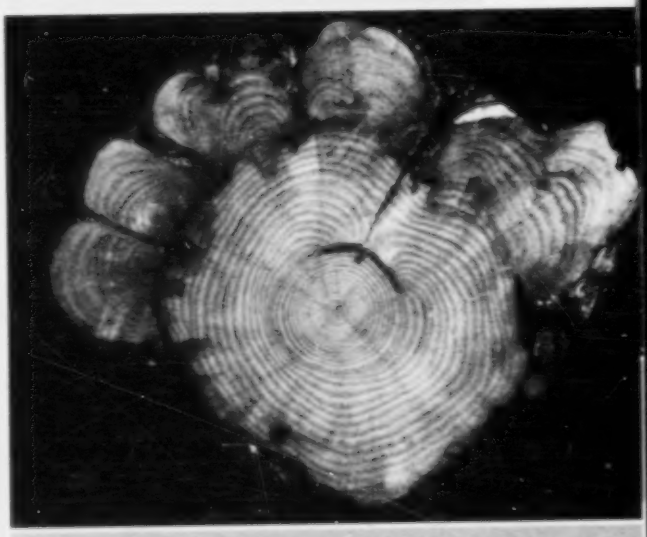
Research Highlight

HISTORICAL FREQUENCY, INTENSITY AND EXTENT OF MOUNTAIN PINE BEETLE DISTURBANCE IN LANDSCAPES OF BRITISH COLUMBIA AND ALBERTA

Researchers from the Canadian Forest Service are studying information stored in tree rings to determine British Columbia's and Alberta's beetle history and the characteristics of past outbreaks. They are comparing that information to current outbreaks to test for beetle virulence potential. The influence of past climate, as inferred from tree rings, on outbreak likelihood is also being investigated. Studies comparing signals from trees in beetle-killed stands with traces from trees in stands affected by surface fires provide insight into the relationship between fire regimes and beetle outbreaks. The degree of release, in terms of diameter-growth gain, sustained by trees that have survived outbreaks is also being studied. For areas where permanent plot data is available, growth gain is being related to initial stand density and severity of outbreak.

Information gained from such studies is increasing our understanding of the regularly recurring nature of mountain pine beetle outbreaks in different climatic and ecological zones, and is critical to effective interpretation of the long-term risk of beetle outbreaks and the influence of climate change on that risk.

Contact: Rene Alfaro
Canadian Forest Service
Pacific Forestry Centre
Victoria, BC
E-mail: ralfaro@pfc.cfs.nrcan.gc.ca



The history of a stand can be traced by examining tree rings. Such dendrochronological research provides information on past infestations and other natural disturbances.

Research Highlight

WILDFIRE RISK ASSESSMENT AND PREDICTION FOR MOUNTAIN PINE BEETLE-KILLED LODGEPOLE PINE STANDS

Large tracts of British Columbia's forests and a number of communities were damaged during British Columbia's unprecedented 2003 wildfire season. Observations made of the fires suggest that fire behaviour is more severe in red-attack beetle stands than in healthy stands. In order to evaluate the extent and magnitude of fuel hazard associated with beetle-killed stands, a team of scientists from the British Columbia Ministry of Forests Fire Management Section is studying fire behaviour characteristics in red-attack beetle stands to quantify effects of infestation on fuel moisture, ignitability and other fire behaviour characteristics such as rate of spread, fire intensity, and crowning potential.

Research into fire behaviour in post-beetle stands will provide information on fire behaviour characteristics such as rate of spread, fire intensity and crowning potential.

This information will be applied to update provincial fuel maps used for operational fire preparedness planning and fire behaviour forecasting in British Columbia. Updated fuel-hazard maps are coupled with information on fire-weather climatology, risk of ignition, and wildland–urban interface areas to prioritize wildfire mitigation and fuel-treatment activities, and hopefully reduce the scope and scale of future wildfires in the province.

Contact: Judi Beck
Fire Management Section
British Columbia Ministry of Forests
Victoria, British Columbia
E-mail: judi.beck@gems6.gov.bc.ca

Research Highlight

ASSESSING ECOLOGICAL EFFECTS OF MOUNTAIN PINE BEETLE SALVAGE OPERATIONS

Control of mountain pine beetle can be integrated with wildlife and sustainable forest management objectives, according to researchers at the University of British Columbia's Centre for Applied Conservation Research. The scientists evaluated potential effects of large-scale salvage operations based on a review of ecological relations and features by forest-dwelling terrestrial vertebrates, freshwater fish and non-forest-dwelling vertebrates. The researchers concluded that, in some instances, salvage practices can be modified to retain potential positive effects on vertebrates; in other instances, they can be modified to reduce negative effects.

The study report includes recommendations for effectiveness and implementation monitoring, and key research questions. These recommendations are framed within the context of the three broad indicators used by the British Columbia Ministry of Water, Air and Land Protection and employed by companies to assess efforts in sustaining biological diversity.

Contact: Fred L. Bunnell
Center for Applied Conservation Research
University of British Columbia
Vancouver, British Columbia
E-mail: fbunnell@ubc.ca

The Mountain Pine Beetle Initiative has completed a synthesis report on the effects of large-scale salvage logging on ecological values

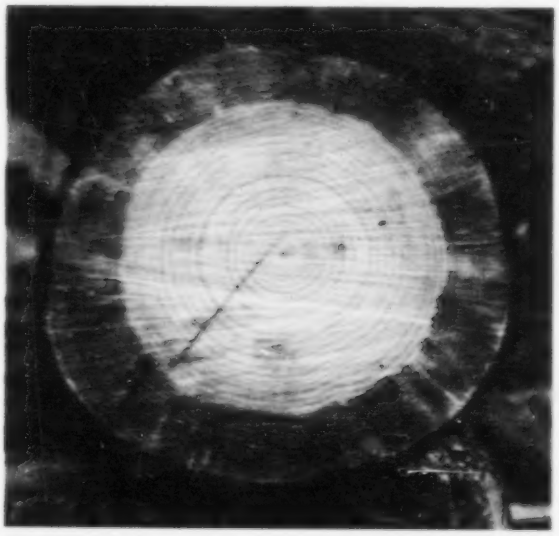
Economic research and development

A strategic element of current Mountain Pine Beetle Initiative research and development is to provide information to complement harvest and production decisions, maintain existing markets, and explore new energy-based market opportunities for manufactured products from post-beetle timber.

Economic Strategic Objective: Provide information to complement harvesting and production decisions, and to maintain markets for manufactured products from post-beetle timber.

The ability to fully capture the potential 600 million cubic metres of beetle-killed timber is limited by market demand, price impacts of increased supply and the rate of deterioration in the wood's processing- and product-performance properties following death. Initiative staff are working with the province and the research community to resolve supply logistics, transportation, manufacturing and marketing issues associated with beetle-killed timber.

British Columbia forest companies are redirecting planned timber development in order to absorb the immediate availability of beetle-infested wood and anticipated reductions in timber quality. Typically, companies will aggressively target high-priority beetle-infested timber for harvest during the current allowable-cut period. Research investigates the relationship between timber quality and time since death in beetle-killed timber. The rate of deterioration will determine the volume of suitable material available for specific forest products during the next five, 10 and 15 years. The research will provide comprehensive documentation to support harvest scheduling and timber processing decisions to enable the highest value capture from the post-beetle fibre resource.



Blue-stained beetle-killed wood is drier, more brittle, more permeable, and contains more resin, more chemical extractives, and a greater number of splits than healthy wood does. These characteristics affect how the wood may be processed and marketed.

The current epidemic is forcing British Columbia forest product companies to adjust technology procurements and sawmill processing strategies to mitigate differences in performance observed within specific product lines. The program is investigating how changes in the physical and chemical properties of beetle-killed fibre affect manufacturing efficiencies within both the solid wood and pulp and paper sectors. Results of the research will facilitate more efficient manufacturing of forest products from the post-beetle fibre resource.

The severity of the current epidemic has precipitated a significant increase in short-term annual allowable cut in British Columbia to allow timely salvage of beetle-damaged timber.

The scale of beetle kill means large volumes of grey-attack timber will not be absorbed into standard manufacturing lines. Natural Resources Canada researchers at the Pacific Forestry Centre are completing a synthesis of biomass energy research and analysing the economics of energy alternatives, including wood pellets and biomass, as an offset for a portion of coal in thermal power plants. The model is being used to examine the carbon credit potential in the economics of biomass-derived energy.

The unprecedented scale of the epidemic is also compelling the British Columbia forest sector to examine opportunities to capture value from the surplus supply through development of alternative products and non-conventional markets. The scope of the challenge presented by the epidemic will extend beyond the volume of timber harvested over the short term to development of value-added structural and non-structural wood products produced from beetle-killed stands over the long term. The Initiative supports research that examines suitability of beetle-killed timber for use in such new value-added products, and how such products may be received in new and existing markets.

Research Highlight

PREDICTING DECAY AND DEGRADE RATES IN STANDING AND FALLEN TREES KILLED BY MOUNTAIN PINE BEETLE

Despite a history of mountain pine beetle outbreaks, little is known about the post-mortality rate of deterioration of wood quality and quantity, or about the rate of change in stand structure due to falling dead trees. This information is essential for planning timing and distribution of salvage harvests that aim to recover the greatest value from the wood over time, and to maintain a future wood supply for forest-dependent communities in beetle-affected areas. Furthermore, the rate of change in stand structure is essential for strategic planning for habitat and other non-timber values.

Researchers from the University of Northern British Columbia are investigating relationships between time since death and time since fall, and measuring wood quality and quantity in different beetle-infested ecosystems. The scientists are sampling trees across a range of sizes, moisture regimes and time since death or fall in one biogeoclimatic subzone. They are also measuring response variables, such as moisture content, extent and cause of decay, and blue-stain penetration along the boles of sample trees. By relating stand-level measurements of frequency of tree fall to site and stand factors that affect rate of wood decay and degrade, the researchers will enable development of models that predict rates of tree fall, decay and degrade following beetle-caused death.

Research into the shelf-life of beetle-killed timber, along with inventory information, processing capacity and markets, are key elements in planning the timing and distribution of salvage harvests.

Contact: Kathy Lewis
University of Northern British Columbia
Prince George, British Columbia
E-mail: lewis@unbc.ca

Research Highlight

SYNTHESIS OF IMPACTS OF INCREASED USED OF CHIPS WITH ELEVATED PITCH LEVELS, DRY CHIPS (STANDING DEAD) AND CHIPS WITH BLUE STAIN ON PULPING

Interior spruce–pine–fir lumber chips are highly prized for their intrinsic brightness and the strength they confer to pulp. However, as provincial harvesting patterns change to reflect new, epidemic-influenced annual allowable cuts, pine content in the mix will increase. Storage of fibre chips from beetle-killed, blue-stained trees will inoculate clean chips with blue-stain fungus. This will mean an increase in blue-stain content of chips used in pulping operations in the province.

A study by researchers from the Pulp and Paper Research Institute of Canada (PAPRICAN) quantifies costs associated with mechanically pulping and brightening blue-stained chips. Two kinds of pulps were made using blue-stained and clean lodgepole pine fibre chips. These pulps were then tested.

Results from these experiments are helping pulping operations in British Columbia focus treatment and preparations of pulps to maintain quality and cost effectiveness.

Contact: Paul Watson
PAPRICAN
Vancouver, British Columbia
E-mail: pwatson@paprican.ca

Results from experiments quantifying costs associated with mechanically pulping and brightening blue-stained chips are helping pulping operations in British Columbia focus treatment and preparations of pulps to maintain quality and cost effectiveness. Photo courtesy of PAPRICAN.

Research Highlight

BIO-ENERGY OPTIONS FOR WOODY FEEDSTOCK

The relatively low energy value of biomass feedstock—including wood—makes its use in industrial bio-energy production a great challenge. In places such as Northern Europe, certain applications, including the use of processing co-products by the forest sector, have successfully used biomass for energy. Natural Resources Canada, Canadian Forest Service researchers at the Pacific Forestry Centre are analyzing the drivers and levels of bio-energy production around the world, and are identifying factors that have led to successful uptake of biomass for energy production. Specific issues important to using mountain pine beetle fibre are discussed, with case studies that examine economic and policy conditions necessary for use of this feedstock for energy.

Two very different sources of biomass energy feedstock characterize the problem: they include co-products from increases in traditional processing, and grey-attack trees harvested as salvage. The researchers' preliminary findings indicate that the economics of using the former are positive, and that capacity for its use in the beetle-affected region is increasing. Study results also indicate that cost considerations—confounded by both time (this being a temporary supply) and distance (the extensive area of outbreak)—make use of dedicated salvage-harvest biomass for energy production uneconomic.

Contact: Brad Stennes
Natural Resources Canada, Canadian Forest Service
Pacific Forestry Centre
Victoria, Pacific Forestry Centre
E-mail: bstennes@pfc.cfs.nrcan.gc.ca

Research Highlight

IMPROVING VALUE RECOVERY OF ORIENTED STRANDBOARD FROM POST-MOUNTAIN PINE BEETLE WOOD

Lodgepole pine trees attacked by mountain pine beetle become grey and dry approximately two years after death. In the near future, decisions will have to be made about processing large quantities of this grey-stage material. One possible end use for dry beetle pine is oriented standboard (OSB). Large volumes of post-beetle wood will have a major effect on the operating costs of OSB plants. As the average moisture content of post-beetle wood can drop below 20 per cent, the amount of fines in processing material is expected to be high. Unfortunately, as the amount of fines increases, the values of OSB properties decrease, wood recovery decreases, and the amount of resin required increases.

Researchers from Forintek Canada Corporation are investigating the technical and economic feasibility of milling the wood specifically for this purpose. By testing water conditioning of dry logs immediately prior to processing and the use of different stranders set-up to see if these variables increase quality and proportion of useable OSB strands to decreased production of fines, the project is helping improve value recovery of OSB manufacturing from grey-stage, beetle-killed logs.

Contact: Martin Feng
Forintek Canada Corporation
Vancouver, British Columbia
E-mail: martin@van.forintek.ca

As more and more beetle-killed timber comes into the supply chain, mills and processing operations will be challenged to resolve supply, transportation, manufacturing and marketing issues associated with beetle-killed timber.

Social processes research

An important element of the Mountain Pine Beetle Initiative Epidemic Risk Reduction and Value Capture Research and Development Program is the study of economic and social indicators used to evaluate community well-being in the wake of the current beetle epidemic.

Many British Columbia communities depend on forest-sector performance. In some communities, 40 per cent or more of after-tax revenues is derived directly from the forest sector. As a result, these communities will initially benefit from increased economic activity derived from the increased post-beetle timber supply. Through time, however, the same communities will be challenged as the forest industry restructures to accommodate projected timber-supply reductions.

Social research: Provide analyses and information to assist the provinces and communities in the post-beetle transition.

The Mountain Pine Beetle Initiative supports research to quantify potential impacts that epidemic-caused changes in timber supply may have on regional economies. The Initiative also supports research to evaluate the ability of communities to adapt to changing socio-economic circumstances associated with large-scale natural disturbance, and supports efforts to increase understanding of social dimensions that influence acceptability of post-beetle management actions within affected communities.

Canadian Forest Service, Pacific Forestry Centre economists are developing a multi-region model of the British Columbia forest sector with timber supply, conversion technologies and demand defined. Transportation links will be used to project and optimize flow of each kind of timber fibre—including logs, chips, lumber, panels, pulp, and wood pellets—both between regions in the province and through export routes out of the province. The researchers will examine policy options meant to minimize medium-term socio-economic displacement within forest-based communities resulting from impacts of future beetle infestations on fibre supplies.

Canadian Forest Service researchers at the Northern Forestry Centre investigated economic impacts of beetle infestations within administrative sub-regions of British Columbia. Baseline economic data compiled from data from business surveys across the affected regions and from Statistics Canada census profiles were used to construct computable general equilibrium models and to examine economic impacts of the changes in timber supply for each sub-region.

Other research funded by the Initiative seeks to identify key social and economic factors that contribute to susceptibility of forest-based communities to impacts from beetle infestation. The project examines both social and economic vulnerability, including distribution of vulnerability among various stakeholders.

Scientists at the University of British Columbia received Initiative funding to develop tools to assess the public acceptability of possible post-beetle forest management alternatives, and to assess community perceptions of the impacts and associated mitigation strategies of alternatives on non-timber and non-market values, including aesthetics and recreation.

Research Highlight

REGIONAL ECONOMIC IMPLICATIONS OF THE MOUNTAIN PINE BEETLE INFESTATION IN THE NORTHERN INTERIOR FOREST REGION OF BRITISH COLUMBIA

Analysis of economic impact provides information regarding implications of policy options or external influences on the economic system. A study by researchers at the Canadian Forest Service's Northern Forestry Centre investigates the regional economic impacts resulting from the current beetle infestation in the Northern Interior Forest Region of British Columbia.

Six study areas within the region are investigated: the Nadina Forest District, the Prince George Timber Supply Area, the Quesnel Forest District, the Central Caribou and 100 Mile House Forest District, the Kamloops Forest District, and the Rocky Mountain Forest District. Baseline general equilibrium economic databases are constructed for each study area using primary and secondary sources. The databases are used to construct a computable general equilibrium model for each area, which are in turn used to simulate future economic indicator levels under different scenarios related to the impact of the infestation on timber supply. Potential offsetting impacts, resulting from possible increased levels of agricultural and tourism activity, are also examined.

Contact: Bill White
Canadian Forest Service
Northern Forestry Centre
Edmonton, Alberta
E-mail: bwhite@nrcan.gc.ca

Research has estimated the economic impacts of the changes in timber supply on forest-based communities and has examined social and economic factors that contribute to community vulnerability from the beetle epidemic.

Research Highlight

SOCIO-ECONOMIC DIMENSIONS OF COMMUNITY VULNERABILITY TO MOUNTAIN PINE BEETLE

Although many communities may be vulnerable to impact by the mountain pine beetle epidemic, the nature and extent of this vulnerability remain unknown. This impedes planning and policy making. The Mountain Pine Beetle Initiative is supporting research to assess community vulnerability. This project examines both social and economic vulnerability, including distribution of vulnerability among stakeholders. By using academic and local assessments of the dimensions of community vulnerability, researchers have determined a set of variables that can be used to quantitatively assess community vulnerability to beetle. In general, those variables fall into three categories: measuring the community's exposure to the beetle, sensitivity to exposure, and resilience to exposure.

The increase in the annual allowable cut from beetle-infested areas will have short-, medium- and long-term affects on timber supply and on forest-dependent communities

The variables are being measured and combined to form a vulnerability index, with index scores assigned to each study community. Analyses using geographic information systems will spatially represent the communities at greatest risk and integrate spatially explicit beetle data with vulnerability-index point data. Maps of the study region, illustrating spatial variation in socio-economic vulnerability, will be used as aids in decision making and policy setting.

Contact: John Parkins
Canadian Forest Service
Northern Forestry Centre
Edmonton, Alberta
E-mail: jparkins@nrcan.gc.ca

Research Highlight

PUBLIC PERCEPTIONS OF MOUNTAIN PINE BEETLE MANAGEMENT OPTIONS

Modern forest visualization techniques have proven invaluable to forest managers by making it possible to visually represent alternative management scenarios that are otherwise only represented by abstract statistics. Researchers at the University of British Columbia are developing the technical capacity to extend current techniques used for increasingly automated generation of near–photo-realistic imagery representing proposed landscape-level change to the current beetle epidemic. These visualizations will be used in a series of structured perceptual experiments aimed at increasing understanding of the social dimension that affects acceptability of management actions among the public. Issues of the public acceptability of possible management alternatives, public beliefs of the origins of this event, how those beliefs frame appropriate management goals post-event and perceptions of impacts and associated mitigation strategies on non-timber and non-market values, including aesthetics and recreation potential, are being investigated.

Contact: Michael Meitner
University of British Columbia
Vancouver, British Columbia
E-mail: Mike.Meitner@ubc.ca

New computing techniques being developed by researchers at the University of British Columbia convert statistical data into images of landscape management alternatives that can be viewed by the public and policy makers to assist in post-beetle salvage harvesting decisions.

Risk reduction research

Much of Canada's forests, including those in British Columbia and Alberta, consists of mature timber with significant vulnerability to forest pests. This inventory limits effective deployment of pest-risk reduction options. Instead, a more realistic option is to pursue risk reduction opportunities by improving efficiency and efficacy of forest pest monitoring, risk modeling, response timing and direct control tools.

development of projections of climatic suitability for the beetle under different climate change scenarios. Early work suggests that suitable range for the beetle is expanding in British Columbia and Alberta, and could spread to include jack pine forests that extend across Canada.

The Mountain Pine Beetle Initiative also supports collaborative research at the Pacific Forestry Centre and the University of British Columbia to develop a robust, practical approach for early mapping of beetle attack using remotely sensed data. Results from this process will be used to monitor emerging populations, and to better inform beetle management decisions.

Risk Reduction: Provide decision-support systems that combine resource inventories and information management with scientifically credible forecasting models to reduce the risk of future large-scale epidemics.

A strategic objective of the Risk Reduction and Value Capture Research and Development Program is to provide decision-support systems that combine resource inventories and information management with scientifically credible forecasting models to reduce risk of future large-scale epidemics. Research efforts are directed towards improved understanding of beetle population dynamics, development of mountain pine beetle dispersal models, improved stand-risk estimates, and early detection and monitoring of pest hot spots. Researchers from the Canadian Forest Service and universities are developing and refining models and tools for predicting where and when future outbreaks may occur, for describing dispersal patterns of the beetle and the effect of dispersal on infestation, and for identifying time-series hot spots (and cold spots) of outbreaks and the conditions that contribute to their occurrence.

Existing models that capture the influence of climate on beetle populations, combined with recent advances in knowledge about beetle biology, are being used to construct maps of past climatic suitability for the beetle. This information, when combined with climate change models, allows

Research Highlight

EFFECT OF CLIMATE CHANGE ON RANGE EXPANSION BY THE MOUNTAIN PINE BEETLE IN BRITISH COLUMBIA

Mountain pine beetle's current range is limited not by available hosts, but by climate unfavourable to brood development. In a study assessing the effect of climate change on range expansion of the beetle, researchers from the Canadian Forest Service combined a model of the impact of climatic conditions on the establishment and persistence of beetle populations with a spatially explicit, climate-driven simulation tool. Historic weather records were used to produce maps of the distribution of past climatically suitable habitats for the beetle in British Columbia. Overlays of annual beetle occurrences on these maps help to determine if the beetle has expanded its range in recent years due to climate.

Examination of the distribution of climatically suitable habitats in 10-year increments derived from climate norms (1921–1950 to 1971–2000) clearly shows increased range of favourable habitats. Furthermore, increases, at increasing rates, in the number of infestations since 1970 in formerly unsuitable habitats indicate that beetle populations have spread into these areas. Given the rapid colonization by the beetle of formerly unsuitable areas during recent decades, continued warming in western North America associated with climate change will allow the beetle to further expand its range northward, eastward and into higher elevations.

Contact: Allan Carroll
Canadian Forest Service
Pacific Forestry Centre
Victoria, British Columbia
E-mail: acarroll@pfc.cfs.nrcan.gc.ca

Research Highlight

ENVIRONMENTAL EFFECTS OF DISPERSAL AND REPRODUCTION OF MOUNTAIN PINE BEETLE

Researchers from the University of Calgary have set out to determine how mountain pine beetles disperse through managed and unmanaged forests. They are evaluating flight potential and host selection as the initial determinants of flight distance. The scientists then are relating that data to tree and stand conditions. Information on size and condition of beetles has been translated into actual flight distances by measuring flight on flight mills. Researchers are also investigating how host-tree selection determines when beetles stop dispersing. Host acceptance and reproductive behaviour are directly assessed as functions of beetle condition and tree state. Together, these variables allow the researchers to predict the probability of a beetle stopping or continuing to move through a stand. Researchers will test the predictions using mark-recapture experiments to empirically observe dispersal in unmanaged, thinned and burned forests.

Research that evaluates flight potential and host selection as the initial determinants of flight distance is being related to tree and stand conditions, and will provide a basis for assessing risk of forest stands to beetle attack.

Together, these studies will provide a robust basis for assessing risk of forest stands to beetle attack, and for devising forest landscapes that may deter beetle movement.

Contact: Mary Reid
University of Calgary
Calgary, Alberta
E-mail:mreid@ucalgary.ca

http://mpb.cfs.nrcan.gc.ca/index_e.html

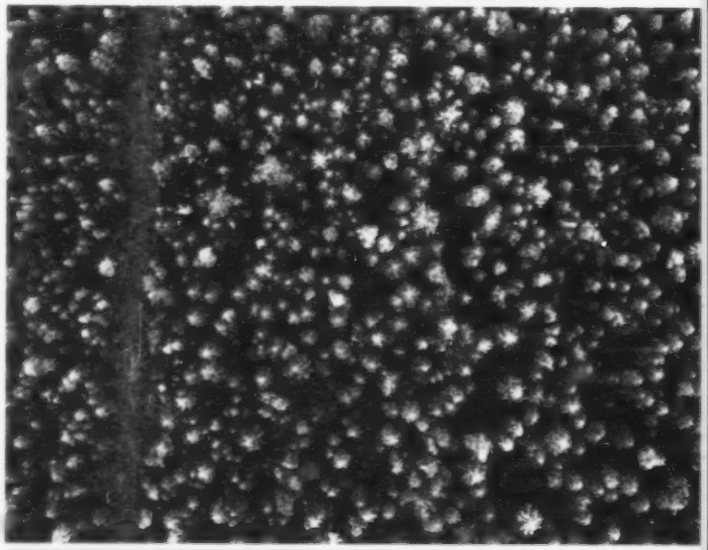
Research Highlight

RED-ATTACK MAPPING BY REMOTE SENSING

A robust, practical approach for mapping beetle red-attack using remotely sensed data was developed by researchers at the Canadian Forest Service's Pacific Forestry Centre. By making use of multiple data sources at different scales, and focusing on integration and synthesis of information, the researchers are enabling the generation of value-added information products that augment existing data or that can be easily incorporated into existing biophysical, economic and timber supply models.

The results provide reliable information on location and severity of red-attack trees. This information helps to predict current attack locations, and drive decision-support systems. Results also affect the risk of future beetle epidemics by improving monitoring and incidence technology.

Contact: Mike Wulder
Canadian Forest Service
Pacific Forestry Centre
Victoria, British Columbia
E-mail: mwulder@pfc.cfs.nrcan.gc.ca
http://bookstore.cfs.nrcan.gc.ca/index.htm



Researchers are using remote sensing technology to map and determine new outbreak areas of the current infestation. Photo courtesy of Terrasaurus Ltd.

Moving Ahead

By investing in research, knowledge transfer, and beetle management, the Mountain Pine Beetle Initiative seeks to reduce the ecological, economic and social impacts of the current beetle epidemic, and reduce risk of future epidemics.

Moving Ahead

LAND-BASED PROGRAMS

Mountain Pine Beetle Initiative land-based programs will build on the foundation of the completed forest-status information by implementing site-specific prescription treatments for existing private forestlands and First Nations forestlands agreements, and by continuing development and implementation of beetle control and management treatments and site restoration within national parks and other federal lands. As well, integration of fuel management within the Initiative's First Nations Forestlands Element will continue on eligible lands to reduce risk of wildfire to communities.

As the beetle epidemic continues to expand into newly infested territories, delivery of land-based programs will also extend to new private non-industrial and First Nations forestlands encompassed within the annually revised emergency mountain pine beetle management zone. The Initiative will assist landowners and First Nations to survey infestation and beetle damage on each of these sites. Capacity building and knowledge enhancement on the subject of beetle management will expand as the Initiative sponsors and presents workshops and other forms of technological transfer to owners of private non-industrial forestlands, members of First Nations bands, and employees of national parks and Department of National Defence sites that have forests affected by the infestation.

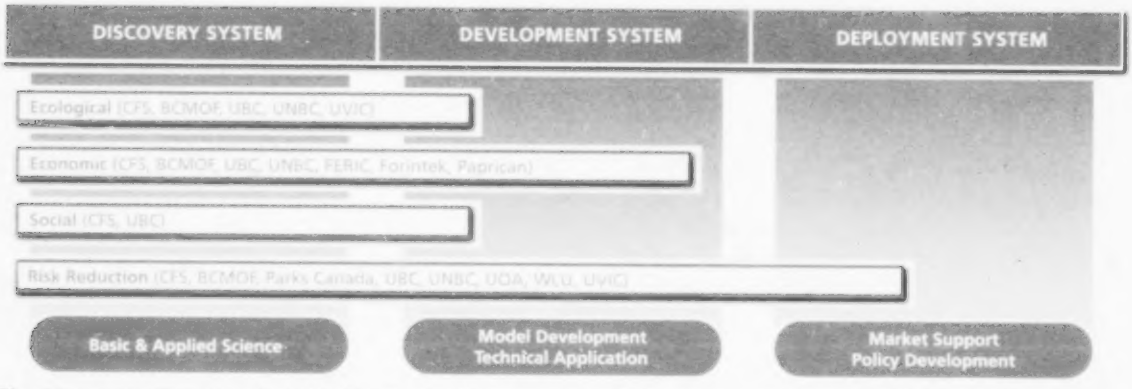
RESEARCH AND DEVELOPMENT PROGRAM

A challenge for Mountain Pine Beetle Initiative research is to effectively capture and promote a level of scientific capability within the Canadian forest sector appropriate to the scope and complexity of the beetle problem. Future improvements in effectiveness and efficiency of pest management programs will be difficult to achieve without concurrent investment in science and technology. The scientific foundation guides development of new policies, predicts and evaluates impacts of different management alternatives, and provides knowledge-based tools for forest managers and resource-based communities.

The Initiative's approach to research and development is based on a strategic framework that extends across the forest sector, from basic research to product development and market access. The framework consists of three innovation components, each of which supports the Initiative's strategic objectives. The components of the Initiative's strategic research and development framework are:

- Discovery System
- Development System
- Deployment System

Each component has associated networks of knowledge providers, information users and economic institutions. The framework provides the platform for development of collaborative solutions and mutually beneficial results. The business model accelerates creation of information- and technology-exchange mechanisms to strengthen the breadth and depth of the value chain.

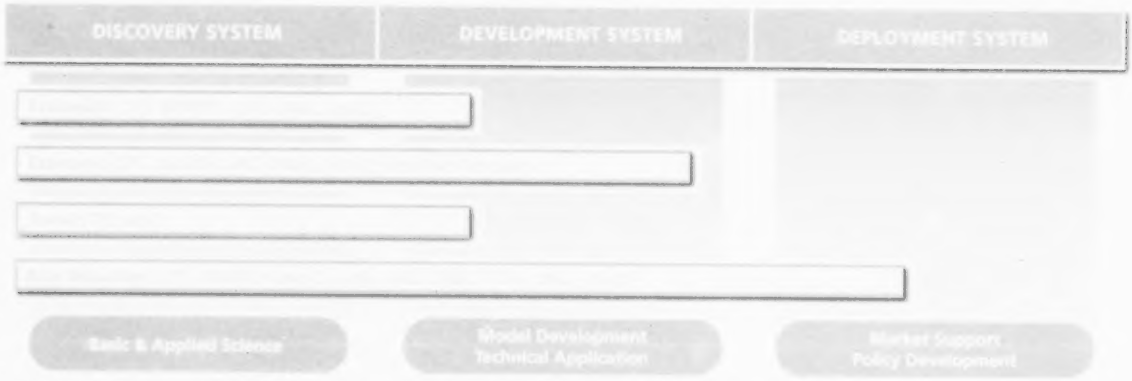


The Mountain Pine Beetle Initiative Strategic Research and Development Framework

An integral component of the work done to date involves capture and synthesis of existing information in support of problem analyses needed to define the scope and scale of future research efforts. In some areas, a large amount of information already exists and, as a result, a number of models have been or are being developed by researchers based on that information. Deployment of some of these models developed within the Mountain Pine Beetle Initiative has begun. Future research in these areas will be limited to refinement of these operational models.

In other areas, data syntheses and problem analyses indicate that information gaps exist and that focused research is needed to fill those gaps. Although models may exist, the information with which the models were calibrated was collected prior to the current beetle outbreak and may have little relevance to post-beetle conditions. Future research in these areas will be driven by the importance of those models to policy development and evaluation of beetle management alternatives.

Finally, as we develop greater understanding of the ecological complexities and economic uncertainties associated with large-scale natural disturbances, new questions emerge that will significantly influence future policy decisions. Future research in these areas will focus on monitoring and mitigation of beetle impacts across widening social, economic and environmental dimensions.



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Appendix: Research and development projects

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For more information on Mountain Pine Beetle Initiative projects, visit: http://mpb.cfs.nrcan.gc.ca/index_e.html

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ECOLOGICAL PROCESSES (1A)

Initiative: 1A1 - Development and delivery of decision support tools

Organization	Project Title
Natural Resources Canada, Canadian Forest Service (NRCan, CFS)	Expansion of beetle-proofing research, and operational evaluation for feedback to adaptive management
NRCan, CFS	Projection of the efficacy of mountain pine beetle management at the landscape scale
NRCan, CFS	Historical frequency, intensity and extent of mountain pine beetle disturbance in landscapes of British Columbia and Alberta
NRCan, CFS	Phytosanitary risks associated with mountain pine beetle-killed trees
NRCan, CFS	A synthesis of the economic efficiency of beetle-proofing management options
FERIC	Review and synthesis of historical adaptive management strategies to control mountain pine beetle: efficacy and economics
British Columbia Ministry of Forests (BCMoF)	Plan for establishment of long-term monitoring plots in mountain pine beetle-killed stands
BCMoF	Test and refine a new approach to stocking assessment in stands resulting from mountain pine beetle-salvage partial cutting
University of British Columbia (UBC)	Predicting stream temperature responses to the British Columbia mountain pine beetle epidemic: test of the predictive model developed by Mellina et al. (2002)
BCMoF	Hydrologic effect of mountain pine beetle infestation and salvage harvesting operations
UBC	Exploring opportunities for mitigating ecological impacts of current and future mountain pine beetle outbreaks through improved planning: A focus on northern British Columbia
University of Victoria	Review and synthesis of potential hydrologic impacts of mountain pine beetle infestation and related harvesting activities in British Columbia
UBC	Possible forest futures: Avoiding predictable surprises of mountain pine beetle management

Initiative: 1A2 - Determination of environmental risks and opportunities

Organization	Project Title
Canadian Forest Service, Pacific Forestry Centre	Effects of fire return rates on forest age distribution and on the susceptibility of lodgepole pine stands to attack by the mountain pine beetle
BCMoF	Wildfire risk assessment and prediction for mountain pine beetle-killed lodgepole pine stands
UBC	Time of burning and stand susceptibility to the mountain pine beetle in Canada's southern Rocky Mountains

Initiative: 1A3 - Development of stand-level decision support tools

Organization	Project Title
UBC	Integrating silvicultural control of mountain pine beetle with wildlife and sustainable forest management objectives
FERIC	Review and synthesis of regeneration methods in beetle-killed stands following mountain pine beetle attack
UBC	Assessing ecological effects of mountain pine beetle salvage operations
University of Northern British Columbia (UNBC)	Assessment of post-beetle impacts on natural regeneration of lodgepole pine
UBC	Factors affecting the ecological legacy of unsalvaged post-beetle stands
UNBC	Stand-level effects of the mountain pine beetle outbreak in the central British Columbia Interior

ECONOMIC PROCESSES (1B)

Initiative: 1B1 - Market support information: aesthetic and performance properties of post-mountain pine beetle wood

Organization	Project Title
UBC	Fitness and pathogenicity of the fungi associated with the mountain pine beetle and other secondary beetles in green attack
UBC	Alternative wood products from blue-stained mountain pine beetle lumber
PAPRICAN	A synthesis of literature on the blue stain impacts on major forest products

Initiative: 1B2 - Market support information: physical properties of post-mountain pine beetle wood

Organization	Project Title
Forintek	Maximizing value recovery from mountain pine beetle-attacked pine for veneer products
Forintek	Implications of properties of post-mountain pine beetle wood for its utilization
Forintek	Optimizing drying of post-mountain pine beetle wood
Forintek	Improving value recovery of oriented strand board from post-mountain pine beetle wood
Forintek	Addressing marketplace durability issues with beetle-killed lodgepole pine
Forintek	A blue-stain and split detection system for optimizing log and plant breakdown
Forintek	Optimization of gluing, lay-up and pressing for mountain pine beetle plywood
Forintek	Optimizing drying and MSR lumber grade recovery of post-mountain pine beetle wood
UNBC	Predicting decay and degrade rates in standing and fallen trees killed by mountain pine beetle
PAPRICAN	Development of a portable rapid assessment tool to quantify wood- and fibre-quality deterioration in standing lodgepole pine trees and decked logs
UBC	Chemical, mechanical, and durability properties of mountain pine-beetle infested timber
NRCan, CFS	Sample design & sample plan for the determination of timber quality deterioration through time on forestlands impacted by mountain pine beetle
UNBC	Evaluation and review of potential impact of mountain pine beetle infestation on composite board production and related manufacturing activities in British Columbia
Forintek	Tree shape and defects data from mountain pine beetle-affected stems

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NRCan, CFS	Phytochemistry investigated with mountain pine beetle, a host tree
NRCan, CFS	A synthesis of the economic efficiency of beetle grooding management options
FERIC	Review and synthesis of historical adaptive management strategies to control mountain pine beetle: efficacy and knowledge
British Columbia Ministry of Forests (BCMoF)	Plan for establishment of long-term monitoring plots in mountain pine beetle-killed stands
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BCMoF	Hydrologic effects of mountain pine beetle infestation and salvage harvesting operations
UBC	Exploring opportunities for mitigating ecological impacts of current and future mountain pine beetle outbreaks through improved planning: a focus on northern British Columbia
University of Victoria	Review and synthesis of potential hydrologic impacts of mountain pine beetle infestations and related harvesting activities in British Columbia
UBC	Possible forest futures: Assessing possible future outcomes of mountain pine beetle management

Initiative: 1A2 - Determination of environmental risks and opportunities

Organization	Project Title
Canadian Forest Service, Pacific Forestry Centre	Effects of fire return rates on forest age-class distribution and on the susceptibility of lodgepole pine stands to attack by the mountain pine beetle
BCMoF	Wildlife risk assessment and guidelines for mountain pine beetle-killed lodgepole pine stands
UBC	Time of burning and stand susceptibility to the mountain pine beetle in Canada's southern Rocky Mountains

Initiative: 1A3 - Development of stand-level decision support tools

Organization	Project Title
UBC	Integrating silvicultural control of mountain pine beetle with wildlife and sustainable forest management objectives
UNBC	Review and synthesis of organizational, ecological, economic, social, policy, technological and public issues
UBC	A working ecological effects of mountain pine beetle salvage operations
University of Northern British Columbia (UNBC)	Assessment of pine beetle impacts on various components of subalpine forest
UBC	Factors affecting the ecological legacy of attacked pine beetle stands
UNBC	Visual assessment of the cumulative pine beetle outbreak on the visual quality of the Quesnel Highway

ECONOMIC PROCESSES (1B)

Initiative: 1B1 - Market support information: aesthetic and performance properties of post-mountain pine beetle wood

Organization	Project Title
UBC	Fungi and pathogens by of the fungi associated with the mountain pine beetle and other secondary beetles in green attack
UNB	Attractive wood products from beetle-killed mountain pine beetle lumber
FAIRCLAN	A synthesis of literature on the blue stain impacts on value based products

Initiative: 1B2 - Market support information: physical properties of post-mountain pine beetle wood

Organization	Project Title
Forintek	Maximizing value recovery from mountain pine beetle attacked pine for lumber products
Forintek	Characterization of properties of post-mountain pine beetle wood for its utilization
Forintek	Optimizing drying of post-mountain pine beetle wood
Forintek	Improving wood recovery and quality in sawn lumber from post-mountain pine beetle wood
Forintek	Addressing marketplace durability issues with beetle-killed lodgepole pine
Forintek	A knowledge and decision support system for optimizing log and lumber grade
Forintek	Optimization of gluing, lay-up and pressing for mountain pine beetle products
Forintek	Optimizing drying and MSR lumber grade recovery of post-mountain pine beetle wood
UNBC	Predicting decay and degrade rates in standing and fallen trees killed by mountain pine beetle
FAIRCLAN	Development of a predictive rapid assessment tool for assessing wood value from stands of standing lodgepole pine trees attacked by
UBC	Chemical, mechanical, and durability properties of mountain pine beetle infested timber
Forintek	Surface design & service plans for the preservation of timbers heavily deteriorated by mountain pine beetle
UNBC	Evaluation and review of potential impact of mountain pine beetle infestation on composite board production and related manufacturing activities in British Columbia
Forintek	Post-mountain pine beetle wood characterization for value-added uses

Initiative: 1B3 - Market support information: chemical properties of post-mountain pine beetle wood

Organization	Project Title
PAPRICAN	Synthesis of impacts on pulping of increased use of chips with elevated pitch levels, dry chips (standing dead), and chips with blue stain
PAPRICAN	Assessment of the economic (pulping and pulp quality) effects of increased lodgepole pine in SPF chip mixtures
PAPRICAN	Evaluation of chipping options for beetle-killed lodgepole pine wood to maintain wood and fibre quality
PAPRICAN	A wood- and fibre-quality deterioration model for mountain pine beetle-infested trees by biogeoclimatic subzone

SOCIAL PROCESSES (1C)

Initiative: 1C1 - Impacts on resourced-based communities

Organization	Project Title
NRCan, CFS	Assessing the economic impacts of mountain pine beetle infestations and other natural disturbance in British Columbia: A regional, multi-regional and provincial analysis
NRCan, CFS	Socio-economic dimensions of community vulnerability to mountain pine beetle
NRCan, CFS	Assessing the economic impacts of mountain pine beetle infestations and other natural disturbance in forest dependent regions of British Columbia: a region-specific economic impact modeling within the emergency bark beetle management area
UBC	Public perceptions of mountain pine beetle management alternatives
UBC	Economic impact of natural disturbances: a review and synthesis of policy responses

REDUCE FUTURE RISK (2D)

Initiative: 2D1 - Analysis of mountain pine beetle population response across a hierarchy of scales

Organization	Project Title
NRCan, CFS	Impacts of climate change on range expansion of the mountain pine beetle
NRCan, CFS	Mountain pine beetle-outbreak development: The endemic-incipient transition
NRCan, CFS	Microbial impacts on larvae of mountain pine beetle
NRCan, CFS	Incorporating present and future climatic suitability into decision support tools to predict geographic spread and risk for the mountain pine beetle
BCMoF	Retrospective spatial analysis and implications of mountain pine beetle in mixed-species stands
NRCan, CFS	Refinement of the Shore/Safranyik mountain pine beetle risk assessment method by incorporation of host susceptibility characteristics
Wilfrid Laurier University	A landscape-level, spatial investigation of the response of mountain pine beetle populations to treatment

Initiative: 2D2 - Spatial modeling of mountain pine beetle populations across a hierarchy of scales

Organization	Project Title
University of Alberta	Modeling infestation and mortality rates for lodgepole pine trees attacked by the mountain pine beetle
NRCan, CFS	Incorporating mountain pine beetle impacts on stand dynamics in stand- and landscape-level models: evaluation and problem analysis
Wilfrid Laurier University	Spatial-temporal analysis of mountain pine beetle infestations to characterize pattern, risk, and spread at the landscape level
UNBC	Modeling of mountain pine beetle transport and dispersion using atmospheric models
UNBC	Mountain pine beetle population studies for prioritization of stand management during outbreak conditions
University of Calgary	Environmental effects on dispersal and reproduction in mountain pine beetle
NRCan, CFS	Mountain pine beetle stands dynamics in Kootenay and Waterton Lakes national parks
Parks Canada	The influence of mountain pine beetle on stand dynamics in Rocky Mountain National Parks, Canada
University of Alberta	Modeling spatio-temporal patterns of mountain pine beetle infestation

Initiative: 2D3 - Enhanced tools to identify, monitor and assess response to mountain pine beetle

Organization	Project Title
NRCan, CFS	Synthesis and assessment of remote sensing techniques for detection of green, red, and grey stages of mountain pine beetle attack
BCMoF	Provincial-level projection of the current mountain pine beetle outbreak
University of Victoria	Literature review: remote sensing of insect infestations
NRCan, CFS	Red attack-stage mapping with remotely sensed data
UBC	Spatial and temporal patterns of mountain pine beetle infestation and susceptibility in newly infested stands within the South Peace region (TFL48) of northeastern British Columbia

Initiative: 1B3 - Market support information: chemical properties of post-mountain pine beetle wood

Organization	Project Title
PAPRICAN	Synthesis of impacts on pulping of increased use of chips with elevated pitch levels, dry chips (standing dead), and chips with blue stain
PAPRICAN	Assessment of the economic (pulping and pulp quality) effects of increased lodgepole pine in SPF chip mixtures
PAPRICAN	Evaluation of chipping options for beetle-killed lodgepole pine wood to maintain wood and fibre quality
PAPRICAN	A wood- and fibre-quality deterioration model for mountain pine beetle-infested trees by [illegible]

SOCIAL PROCESSES (1C)

Initiative: 1C1 - Impacts on resourced-based communities

Organization	Project Title
NRCan, CFS	Assessing the economic impacts of mountain pine beetle infestations and other natural disturbance in British Columbia: A regional, multi-regional and provincial analysis
NRCan, CFS	Socio-economic dimensions of community vulnerability to mountain pine beetle
NRCan, CFS	Assessing the economic impacts of mountain pine beetle infestations and other natural disturbance in forest dependent regions of British Columbia: a region-specific economic impact modeling within the emergency bark beetle management area
UBC	Public perceptions of mountain pine beetle management alternatives
UBC	Economic impact of natural disturbances: a review and synthesis of policy responses

REDUCE FUTURE RISK (2D)

Initiative: 2D1 - Analysis of mountain pine beetle population response across a hierarchy of scales

Organization	Project Title
NRCan, CFS	Impacts of climate change on range expansion of the mountain pine beetle
NRCan, CFS	Mountain pine beetle outbreak development: The endemic-incipient transition
NRCan, CFS	Microbial impacts on larvae of mountain pine beetle
NRCan, CFS	Incorporating present and future climatic suitability into decision support tools to predict geographic spread and risk for the mountain pine beetle
BCMoF	Retrospective spatial analysis and implications of mountain pine beetle in mixed-species stands
NRCan, CFS	Refinement of the Shore/Safranyik mountain pine beetle risk assessment method by incorporation of host susceptibility characteristics
Wilfrid Laurier University	A landscape-level, spatial investigation of the response of mountain pine beetle populations to treatment

Initiative: 2D2 - Spatial modeling of mountain pine beetle populations across a hierarchy of scales

Organization	Project Title
University of Alberta	Modeling infestation and mortality rates for lodgepole pine trees attacked by the mountain pine beetle
NRCan, CFS	Incorporating mountain pine beetle impacts on stand dynamics in stand- and landscape-level models: evaluation and problem analysis
Wilfrid Laurier University	Spatial-temporal analysis of mountain pine beetle infestations to characterize pattern, risk, and spread at the landscape level
UNBC	Modeling of mountain pine beetle transport and dispersion using atmospheric models
UNBC	Mountain pine beetle population studies for prioritization of stand management during outbreak conditions
University of Calgary	Environmental effects on dispersal and reproduction in mountain pine beetle
NRCan, CFS	Mountain pine beetle stands dynamics in Kootenay and Waterton Lakes national parks
Parks Canada	The influence of mountain pine beetle on stand dynamics in Rocky Mountain National Parks, Canada
University of Alberta	Modeling spatio-temporal patterns of mountain pine beetle infestation

Initiative: 2D3 - Enhanced tools to identify, monitor and assess response to mountain pine beetle

Organization	Project Title
NRCan, CFS	Synthesis and assessment of remote sensing techniques for detection of green, red, and grey stages of mountain pine beetle attack
BCMoF	Provincial-level projection of the current mountain pine beetle outbreak
University of Victoria	Literature review: remote sensing of insect infestations
NRCan, CFS	Red attack stage mapping with airborne sensor data
UBC	Spatial and temporal patterns of mountain pine beetle infestation and susceptibility in newly infested stands within the South Peace region (TFL48) of northeastern British Columbia

PROGRAM CONTACTS

Mountain Pine Beetle Initiative	Bill Wilson, Director Mountain Pine Beetle Initiative and Policy Research Natural Resources Canada Canadian Forest Service 506 West Burnside Road Victoria, BC V8Z 1M5 Telephone: 250-363-3330 or 1-888-255-7041 Fax: 250-363-0775 bwilson@pfc.cfs.nrcan.gc.ca
Private Forestlands Rehabilitation Program Federal Forestland Rehabilitation Program–First Nations Element	Nello Cataldo, Program Manager Natural Resources Canada Canadian Forest Service 506 West Burnside Road Victoria, BC V8Z 1M5 Telephone: 250-363-6014 or 1-888-255-7041 Fax: 250-363-0775 ncataldo@pfc.cfs.nrcan.gc.ca
Research & Development Program	Dave Harrison, Chief Implementation Officer Mountain Pine Beetle Initiative Natural Resources Canada Canadian Forest Service 506 West Burnside Road Victoria, BC V8Z 1M5 Telephone: 250-363-0723 or 1-888-255-7041 Fax: 250-363-0775 daharris@pfc.cfs.nrcan.gc.ca

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